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SEX

By PATRICK GEDDES AND J. ARTHUR THOMSON

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SEX

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SEX

CHAPTER I

THE STUDY OF SEX

Objections to the study of sex—What sex has meant in the past—What sex means to-day—What sex may come to mean—Various ways of studying sex.

OBJECTIONS TO THE STUDY OF SEX.—To many otherwise sensible people, even the word "sex" is abhorrent, still more a book about sex. They will not, therefore, be reading this volume, but their objections may be considered. (a) In some cases the repugnance expresses an organic lack of sympathy with the aim of science, for many estimable people have no use for scientific analysis. They are lacking in the curious spirit, and are not worried by obscurities. They are not interested in any theory of the internal tides that sway them. To those who are built on those lines, there is no more to be said. One feels, however, that while ignorance may be bliss when everything is plain sailing, some accurate knowledge is likely to be useful when the bark of life gets near the rocks in stormy weather. Science is for the control of life, as well as for its enlightenment.

(b) In others the repugnance comes from the poetic and artistic side, and recalls to us the warning tale of Amor and Psyche. Love, they rightly say, is the most wonderful thing in the world; to inquire into its mysterious origins and pre-human analogues repels us. Why thus dig at the roots of the Mystic Rose? Is there not risk of losing by scientific analysis far more than one gains? Even the savage mother very long ago preferred—what she sometimes still prefers—her poetic fancy of the child-spirit entering her womb from the totem-ground, where desirable qualities of strength, swiftness, endurance, and the like were actualised or symbolised, to an acknowledgment of the naked fact of physical paternity! To those who feel so strongly that “love” is an artistic preserve—a charmed corner of the Earthly Paradise—where science is a trespasser, little can be said by us biologists. Unless it be this, that from their position it is impossible to see one of the biggest facts about “love”, namely its evolution. Perhaps this also, that when the steps of the evolution of love are faced and climbed, the poetic and spiritual possibilities are found to be more assured than ever, since they appear henceforth, not merely as the dreams of the poet, but as the promise of the race. And what are most dreams, after all, but tendrils—coarse and fine—groping or feeling after the hitherto unattained?

(c) For others the repugnance is more intellectual and deliberate. To talk about sex, they say, makes for morbid self-consciousness, for indelicacy, even if not impurity.

To bring the facts of sex into broad daylight is obscenity; to disclose the organic springs of love is to degrade Man to the brute level; to raise into the focus of consciousness what ought to remain sub-conscious is a "psychical rape." The latest and unforgivable sin of a materialistic and scientific system of education is thus to presume to give any instruction whatever in regard to the process by which the race is continued! And how much more awful even to broach the subject of the Scylla and Charybdis of adolescence!

We should not be writing this little book at all—when more agreeable occupations invite us—did we not believe that the people perish for lack of knowledge—of sex; that it is ignorance, not science, which engenders pruriency and communicates filthy-mindedness; that for lack of a little instruction many are made miserable when they should be happy, many even ruined, in soul and in body. There is too much mist about the life-journey, from its origins and at its climax—mists dark and unwholesome, favouring errors of judgment and errors of conduct; and of the ever-brightening lights of science there can be few better uses than here and there to guide the wayfarer, even though they may not yet serve to clear all the mists away.

One appeal we would make to those who dread in sex only the dangers of the knowledge of good and evil, and who, as we think, fail to see that here lies the way towards the tree of life as well. Are not physicians, alienists, and nurses precisely the people who see most of sex in its diseased forms? But are they

thereby in anyway more tempted towards sin? Surely otherwise. While as to normal sex, which essentially interests us here, and as at heart and through life zoologists and botanists, each and both of us, what harm have we to tell of our simply or magnificently sexed animals, our gloriously sexed flowers? And coming to the human species, and to our lifelong friends the painters, above all the sculptors, who, beyond any of us, study life naked and unashamed, have not these expressed for every age and generation, its highest ideals, human or divine?

WHAT SEX HAS MEANT IN THE PAST.—There might have been a world without sex—a parthenopeia—of which we get a hint from the swarming generations of green-flies on our rose-bushes and hop-vines, which, all the summer through, increase by virgin birth, with not a single male to be seen till the autumn. The question thus arises, Why might not the organic world have been run on sexless lines? We shall see later on how naturally sex arose in the early days, or rather ages, of organic evolution, and that it has ever been one of the conditions of progress. Maternity itself would probably have ceased if there had not been the love of mates. Strong as is the vital impulse, it probably could not have reached beyond a certain level had it not evoked the device of sex, and thus renewed its inspiration for the uplift of the type, as well as encouragement, through a new life-ecstasy, of its individuals.

In mankind the fact of sex has saturated through history. It is not improbable, as

Mr. Heape has maintained, that the ancient systems of custom and belief which we know as Exogamy and Totemism are in origin characteristically Male and Female expressions respectively. The specialisation of the mother and home-maker made the consolidation of the family possible. The division of labour between the sexes increased the likelihood of invention and opened up different lines of occupation, discipline, and culture, which have often crossed and influenced one another. In many ways, intellectual, emotional, and ethical, there has been alternate stimulus between the sexes. There has been a mutual culture, and sometimes a mutual degradation. Love and passion have stimulated, if not indeed created, music and dance, painting and other arts; they have been among the mainsprings of poetry; they have entered into the heart of religion—from the widespread ancient phallic worships (which have been too harshly judged, from their defects and vices alone), down to much in the latest cults of to-day. Sex-prompted enthusiasms have led to high ethical endeavours, as in chivalry and its quests, and even in wars, though these may have left the world the poorer after them.

To those who may think that we are making too much of the rôle of sex in history we would suggest that they read, for instance, Karl Pearson's *Chances of Death*. From his interesting study of the Aryan terms for sex and kinship, he concludes "that the sex-instinct, as one of the two chief motors of primitive life, has been chiefly instrumental in creating,

not only terms for relationship, but also terms for the chief human affections and desires." . . . "Many roots have originally a sexual sense, and are by analogy or association afterwards used for wider household, agricultural, or social occupations." "Accordingly, if we find in the sexual impulse not only the source of a developed terminology for relationship, but also the first germs of the social instincts in man, shall we not cease to regard it as "a most unlovely germ of appetite," and recognise it for what it really has been—nay, still really is—the ultimate basis of the very highest, as well as of the very lowest, phases in human action and human feeling?"

WHAT SEX MEANS TO-DAY.—This little word covers half the happiness of mankind, and half the misery too—indeed, what pessimist would not say more! It brings about the re-arrangement of the whole life at adolescence, and gives the individual a fresh start—up or down. It is the organic tendril that fastens the growing spirit to the most enduring supports in our external heritage; in art and literature and great example. It is the physical basis of the most powerful emotion in human life—the love of mates, and it is capable of rising higher and falling lower than any other impulse we know. It gives wings or shackles; oftenest, a little of both.

The seamy side is indeed painfully obvious. Morbidities and vices in adolescence are all too common. Many lovers fail in continence. Many marriages sink into commonplaceness and stupor, into quarrelsomeness or indiffer-

ence. The ranks of those who habitually buy and sell sexual gratification are crowded. Unnatural vices lurk in dark places. There are many who have allowed their minds to become unclean, who keep up the trade of pornographic printing, or chew the cud of filthy stories, whose thoughts are always turning to the flesh and the lusts thereof, who can hardly look at a woman without becoming adulterous in heart. In many men who are not unhealthy-minded there is a selfish celibacy which postpones marriage for the "assured position" that best helps a man to life-ruin. In the old stories the lover galloped boldly off with his lady; but nowadays the motor-car serves oftenest to postpone the wife—till love is past its youth. On the other side, too, our modern wealth-spirit fosters feminine selfishness, and spreads that love of untaxed pleasure which shirks maternity or minimises it. In too many of the lives which prosperity has freed from strain or struggle for existence, it seems as if not only the lights of chivalry and romance had gone out, but even of everyday affection and courage also.

WHAT SEX MAY COME TO MEAN.—A study of the past and the present should not be without its suggestions of the possible. What are the lines of change that seem feasible and not too Utopian? (1) A gradual introduction of carefully thought-out sex-education, differentiated for age and circumstances, is likely to do much towards healthy-mindedness, towards lessening morbid brooding, towards a wholesomer view of everything

connected with the continuance of life. (See Chapter VIII.)

(2) Moral education, too often neglected or unskilled in the past, is likely to do much in the way of renewing that vital continuity of upward growth which is so often and so easily distorted or broken, between the simplest organic dreamings and stirrings of sex-impulse and the ideals of lover and poet, of eugenist and statesman. The biological setting is invaluable, but it tends fundamentally to be matter of fact; it must be complemented by an ideal setting. Hence (were it but as the surest way to keep evil out) the noble examples of the past, the possibilities of the future, should pre-occupy the mind. Only with this dual education, organic yet ideal, physiologic yet poetic, can our complex modern city life be again grown healthily, and become, as in the best and simplest rustic life of old, healthy from root to flower.

(3) It seems legitimate to look forward to a very considerable lessening of the troubles of adolescence, when doctor and psychologist, teacher and parent find time to unite their brains in the task. There can be no doubt that the ideal of preventive medicine has not been sufficiently borne in mind in connection with this critical period, and that things are left to themselves in a fatalistic fashion. There should be more preparation for the probable storms—a preparation which many savage tribes have tried to meet in a manner that makes us ashamed of our own “muddling through.” It is likely that the establishment

of frank relations between young people and their physician will save many from miserable years and even from shipwreck.

It may also be suggested that one of the gains of the study of sex will be a better understanding of many phenomena which burden and grieve the spirit. The saying, "To know all, is to forgive all" is a warning to the intolerant; but there are yet more useful sayings, since it is not of such great moment whether *we* forgive or not. What is important to our successors is whether Nature forgives. What is important is the practical action we take in furthering or discouraging, and it is here that understanding is of essential importance.

It is a fact, for instance, that we have in our midst the persistence of "fossils of several stages of sexual habit." In regard to these we know better what to do or what not to do when we see them in their historical significance. Sex-festivals, as in some parts of Russia, for instance, with their strangemingling of religious emotion and sexual license, are not inexplicable perversions of a pathological character so much as survivals of a primeval civilisation. Other instances may be found nearer home, *e.g.* in that persistent and deliberate ante-nuptial experimenting as to the fertility of a proposed marriage, which has lingered so long in northern countries.

VARIOUS WAYS OF STUDYING SEX.—The problems of sex have been attacked along various lines of investigation. (*a*) There is the historical method which traces the relations of the sexes through the ages, which

deals with the history of marriage, of adolescence-ceremonies, of courtship, of concubinage, of prostitution, and so on. It varies, of course, as emphasis is laid on the anthropological, the economic, or the religious aspects of the facts, but its method is definitely historical. It aims at tracing out the evolution of the sex-relations from their pre-human to their human, from their primitive to their civilised expressions.

(b) Another method is that of comparative anthropology, which studies the customs at present to be observed in different peoples, especially of those who are called savages, who may be more profitably called our "contemporary ancestors." Thus the study of the aborigines of Central Australia, as pursued by men like Spencer and Gillen, has yielded very valuable results, especially those bearing on exogamy and totemism. But without going outside our own civilisation there is much to be gained from a comparative study of customs, rites, and lingering superstitions. Logically pursued, this comparative method may be extended to a study of the sex-relations among animals.

(c) A third method is biological—the study of sex as seen in animals and plants, and this is usually pursued along two somewhat different lines. On the one hand, we have physiological investigations, into the rôle of sex-functions in the internal economy of the organism; on the other hand, we have the study, more observational than experimental, of the expressions of sex in plant and animal, in insect and bird, in amphibian

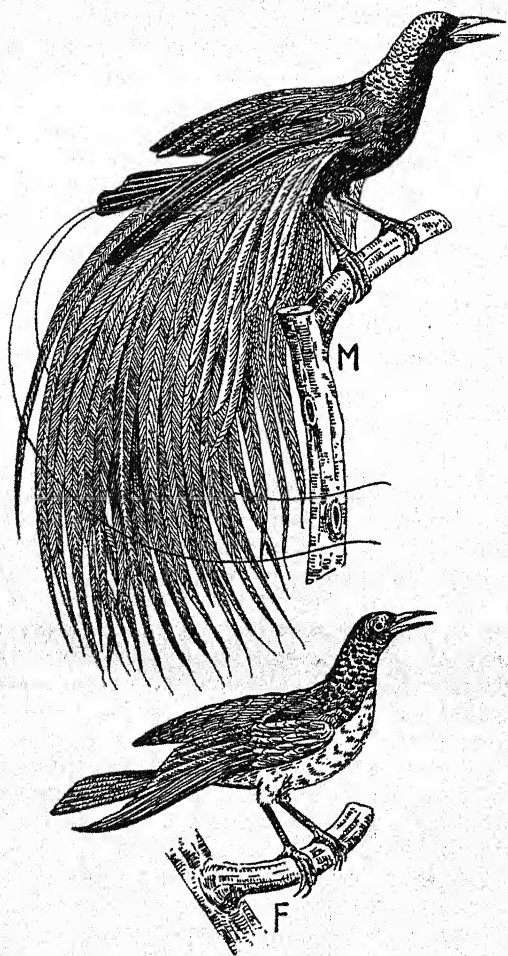


FIG. 1. A Bird of Paradise—*Paradisaea apoda*. The decorative male (M) and the relatively plain female (F). (After O. Hertwig.)

and mammal. All the different modes of sexual reproduction, all the different illustrations of sex-dimorphism, all the forms of mating, have to be studied (Figs. 1 and 2).

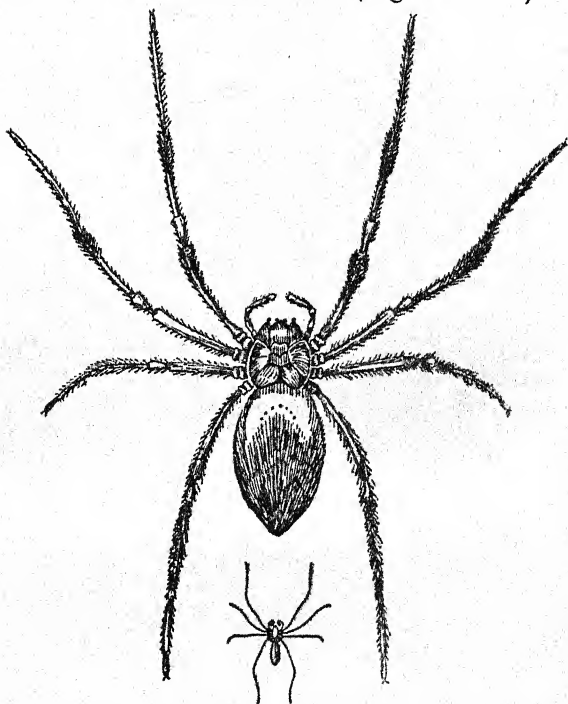


FIG. 2.—Minute male and large female spider, *Nephila nigra*, $\frac{1}{2}$ natural size. (After Vinson.)

The more precise physiological study passes insensibly into medical inquiries as to the normal and abnormal exercise of sexual functions, as to the phenomena of adolescence,

maturity and the climacteric. The more general Natural History study passes insensibly into psychological inquiries as to the sexual impulses, instincts, and emotions, as to the rise and progress of that human complex which we call "love"; and thence, alas, into its pathology also.

In our insistence on the fundamental necessity of the biological approach—apart from which human nature cannot be rightly understood—we are far from falling into the fallacy of forgetting that the biological interpretation requires to be supplemented by the psychological and the social. We wish to make our position in this respect quite clear. Through and through, and back to the ovum, Man is a mammal, with a mammal's structure and functions, development and pedigree, with a mammal's strength and weaknesses. Truly, "all flesh is not the same flesh, but there is one kind of flesh of men, another flesh of beasts, another of fishes, and another of birds,"—there is specificity through and through; yet there is a common ground of protoplasm that makes the whole world kin; and Man cannot disown his mammalian ancestry. He is solidary with the animal creation and with mammals in particular.

On the other hand, while Man still has his feet, as it were, in the natal mud, he has hitched his wagon to a star. With his power of rational discourse, his awareness of his own history, and his capacity for controlling his conduct in relation to general ideas and ideals, he is able to pass far beyond animal confines. Therefore we have sympathy with

a recent writer who says : " The links that bind a young man in the pride of life with a rutting stag, or a mother and her baby with a she-bear and her cubs, are insignificant compared with the differences that divide them. Human conduct, human happiness, and the present and future of the human race are bound up with the differences between man and animals, and not with the resemblances." We should say "with the differences as well as with the resemblances," and we should alter the word insignificant to "of less moment than"; but the quotation expresses an important protest against a too simple "biologism," and with this protest we heartily concur.

Yet our course of action must be not to make less of biology either in enquiry or in use, but of the higher sciences more—of psychology, ethics, and social science for choice.

CHAPTER II

THE EVOLUTION OF SEX

Ancient origin of sex—The case of Volvox—Significance of conjugation in the Protozoa—Body-cells and germ-cells—Advantages of sexual reproduction—Sperm-cells and egg-cells—Significance of fertilisation—Males and females—Testes and ovaries—Sex-dimorphism—Sex-awareness—Physical fondness—Æsthetic attraction—Co-operation of the sexes—Love.

IN the volume *Evolution* in this Library, we have discussed some of the great steps in the history of organisms: the appearance of the relatively simple Protists; the parting of

the ways between plants and animals; the differentiation of Protozoa and Protophyta from one another and among themselves; the establishment of multicellular bodies; the beginnings of brains and of behaviour; the evolution of the dominant types of the animal kingdom; and, finally, the emergence and ascent of Man—the supreme Mammal. We have now to inquire into the evolution of sex and the significance of the various steps so far as these can be read at present.

ANCIENT ORIGIN OF SEX.—The cords of human love are complex, even in its average expressions in civilised mankind. There is a subtle interweaving of strands—physical and psychical, æsthetic and intellectual, individual and social. Yet in spite of all transfiguration, the flesh and blood attraction persists, and we land in fallacy if we forget that these sex-impulses which are at once the glory and the shame of mankind—and this increasingly throughout the ages—have a yet inconceivably longer history behind them, and thence spring up within us with the tremendous momentum of the organic past.

It is a significant fact that we are confronted with sex at the very roots of the genealogical tree—in the primeval sub-kingdom of the Unicellulars, the Protozoa and the Protophytes. In these relatively simple organisms multiplication takes place by fission or by budding, or by spore-formation; but along with these modes of multiplication there is a quite distinct process, that combination of two individuals which is called conjugation. It

used to be believed that the simplest organisms showed no sexual reproduction, but subsequent researches have shown that this is very far from being the case. Many single-

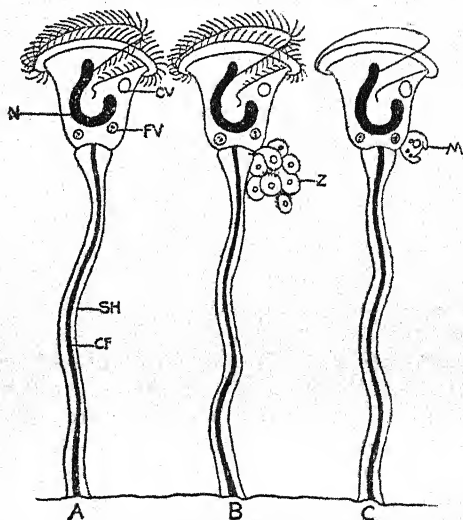


FIG. 3.—The Bell-Animalcule—Vorticella. A, a typical individual showing contractile fibre (CF) inside a non-contractile sheath, the twisted nucleus (N), a contractile vacuole (CV), a food-vacuole (FV), the mouth, and the surrounding cilia. B, an individual which has in part divided into a cluster of small units or microzooids (Z). C, an individual, which may almost be called female, with which a minute individual or microzooid (M), which may be almost called male, is conjugating.

celled organisms unite in pairs and two become one; a total conjugation in which there is obviously so far a decrease, not an increase in numbers. Others, such as many ciliated Infusorians, show partial conjugation, that is,

they become closely united and exchange nuclear elements, after which they separate again. In other cases, the ordinary forms produce special elements (spores) which conjugate, and these are sometimes dimorphic—macrospores and microspores—corresponding to the eggs and sperms of higher animals.

In the life history of the common bell-animalcule, *Vorticella* (see Fig. 3), a small-sized free-swimming individual attaches itself to and bores into another individual, of normal size, which remains moored by its contractile stalk to the water-weed. What have we here but male and female in miniature? It is true, of course, that most of the Protozoa remain strictly unicellular (or perhaps one should say non-cellular), so that they can only be *analogues* of males and females among multicellular creatures. They correspond, indeed, not so much to higher organisms, as to the sex-cells of higher organisms; they are like ova and spermatozoa which have not formed "bodies." But the important fact is that even among the Protozoa we find examples of special reproductive units which combine in pairs, and are dimorphic—macrospores and microspores. For here we are at the beginning of sex.

THE CASE OF VOLVOX.—The second step on the ladder is best illustrated by Volvox, an Infusorian colony, not uncommon in clear ponds, which shows us a body in the making. It is a beautiful green ball of a thousand or ten thousand flagellate cells, according to the species, bound to one another by bridges of protoplasm. It rolls itself quickly through

the water and feeds in part at least like a green plant. But let us consider its reproductive relations.

It occasionally happens that a component unit of the ball of cells may become reproductive and divide to form a daughter-colony (see Fig. 4A) without more ado. This is an almost vegetative way of multiplying, at least a parthenogenetic one. But in other

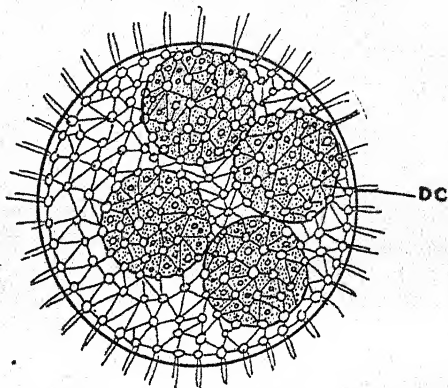


FIG. 4A.—A Volvox colony showing in the interior four daughter-colonies (DC), produced asexually. (After Klein.)

conditions, when nutrition is checked, a less direct mode of reproduction occurs. Some of the cells in the living ball become large, well-fed elements—the ova; others, less anabolic, fade from green to yellow, divide and re-divide into many minute units—the spermatozoa. Here we see the formation of dimorphic reproductive cells in different parts of the same organism. But we may also find Volvox colonies in which only ova are being produced

(see Fig. 4B), and others in which only sperms are being produced (see Fig. 4c). The former

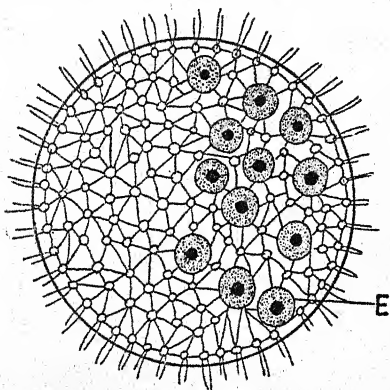


FIG. 4B.—A Volvox colony in a female phase, producing numerous ova or egg-cells (E). (After Klein.)

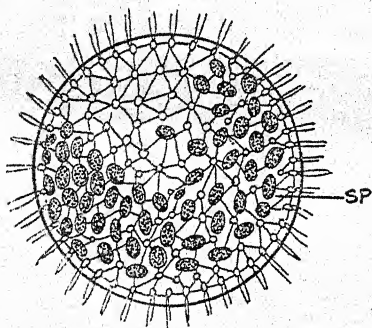


FIG. 4c.—A Volvox colony in a male phase, producing clusters of male-cells or spermatozoa (SP). (After Klein.)

seem to be more vegetative and anabolic than the latter; we may begin to call them female and male organisms respectively; for

here we are at the foundation of the differences between the two sexes. But so far as we know there is no "sex-behaviour" in these two kinds of colonies. The minute spermatozoa, restless and anarchic from first to last, are set free into the water, and some of them coming into the vicinity of ripe female colonies are attracted to the ova—attracted from a slight distance by that more or less mysterious attraction, of which our first germ of knowledge is expressed in the technical word "chemotaxis."

SIGNIFICANCE OF CONJUGATION IN PROTOZOA.—In his fundamental investigations on the conjugation of Infusorians, Maupas inquired into the significance of the process. He asked, for instance, whether the conjugation accelerated subsequent division—the ordinary process of asexual multiplication which these Infusorians exhibit. His answer was a decided negative. While a pair of Infusorians (*Onychodromus grandis*) were engaged in conjugation, a single individual had, by ordinary division, become the ancestor of from forty thousand to fifty thousand individuals. He showed, moreover, that the intricate internal changes associated with conjugation and the subsequent reconstruction, involved a prolonged inertness during which the organisms were exposed to great risks from their enemies.

Puzzled by this result, Maupas made a more extended series of observations. In November 1885 he isolated an Infusorian (*Stylonichia pustulata*) and observed its generations till March 1886. By that time there

had been two hundred and fifteen generations, produced by ordinary division, and since these organisms do not conjugate with those of the same stock, there had been no conjugation. At the date referred to, however, it was observed that something had gone far wrong. The individuals were being born old and debilitated; the powers of nutrition were lost; and the asexual multiplication came to a standstill.

Meanwhile, before the generations had exhausted themselves, several of the individuals had been restored to their natural conditions, where they conjugated with unrelated forms of the same species. One of these was again isolated and watched for five months. In this case, up till the one hundred and thirtieth generation, the organisms showed themselves able to conjugate with unrelated forms when removed to fresh conditions. Later on, even this power was lost, and at the one hundred and eightieth generation the individuals of the same family were observed making futile attempts to conjugate with each other.

What happened in these isolated colonies was a wholesale degeneration, both in structure and function. The individuals decreased in size until they were only a quarter of their original proportions, they showed very marked nuclear degeneration, the powers of feeding and dividing came to an end, the senile stock finally died out.

From all this Maupas drew a natural inference—that there is a limit to the number of successive asexual divisions, and that conjugation must occur, else the whole life

ebbs. The conjugation may be dangerous for the individual, it is a loss of time so far as immediate multiplication is concerned, but it is necessary to keep up the vigour of the stock. Without it, the Protozoa, which are otherwise practically exempt from natural death, must die. Conjugation is the necessary condition of their eternal youth. The experiments made by Maupas were conducted with great care, and they formed (along with other facts) the basis for what is sometimes called the "dynamic" theory of conjugation—that it is "a satisfying of an inherent periodic physiological need of living matter, resulting in a renewal of the vigour of the cell." But subsequent experiments have given a somewhat new complexion to the facts. It has been shown, for instance, that Infusorians are extraordinarily sensitive to their own waste products, and it has been suggested that the degeneration described by Maupas was due to self-poisoning rather than to the absence of conjugation.

Some subsequent investigators have watched hundreds of successive asexual generations without seeing the slightest trace of senile degeneration. Calkins has cultivated the slipper animalcule (*Paramœcium*) for over six hundred generations without conjugation, by giving beef extract when degeneration threatened to set in. The same warding off of evil has been obtained with the same Infusorian by stimulating with infinitesimal quantities of alcohol, strychnine and the like. The trend of recent work has been to suggest that in a perfect environment conjugation

may be dispensed with. But this does not of course contradict the view that the conjugation of unrelated forms may serve to invigorate the constitution.

From the recent investigations of Woodruff at Yale, we select one experiment. On May 1, 1907, he started with a "wild" slipper-animalcule (*Paramœcium aurelia*) which was isolated from an aquarium. When it had divided into two, and each of these into two, the four individuals were isolated to form the starting-points of four pedigree-lines. "The pedigreed culture has been maintained by a specimen isolated from each of these lines practically every day up to the present time (May 1, 1912), thus precluding the possibility of conjugation occurring and facilitating an accurate record of the number of generations attained." The varied culture-medium was invariably boiled so as to render the accidental introduction of "wild" individuals impossible.

During the five years ending May 1, 1912, 3029 generations were observed, and those at the end were as healthy as those at the beginning! There were 452 generations in the first year, 690 in the second, 613 in the third, 612 in the fourth, and 662 in the fifth. The mean rate was over three divisions in forty-eight hours. No periods of marked physiological depression occurred—the variations of rate that were observed being either normal rhythms or the effects of environmental changes of temperature and culture medium. Woodruff concludes that "the protoplasm of a single cell may be self-sufficient to reproduce

itself indefinitely, under favourable environmental conditions, without recourse to conjugation." His experiments indicate that senescence and the need of fertilisation are not primary attributes of living matter.

Without surrendering the idea that conjugation, though not necessitated by a long succession of asexual reproductions, may serve to re-invigorate the protoplasm when the environment is not perfect, we are led to look about for some other part that conjugation may play in the life of the race. The suggestion has been made that it enables the organism to withstand changed environmental conditions—a view which may be readily combined with the idea of re-invigoration. It has been suggested, also, that it may be a process by which the average character of the species is sustained, disadvantageous peculiarities of any individual Protozoon being counteracted by other characters in the unrelated neighbour with which it conjugates. Or it may be that the process of conjugation is a source of variation by bringing about new combinations among the essential substances of the two conjugates. The recent work of Jennings supports the view that the significance of conjugation lies in securing biparental inheritance, which often implies variation. When the conditions of life are untoward, conjugation is apt to occur, and it may be followed by new combinations of qualities, some of which are suited to the altered conditions of life. Conjugation promotes variations, and some of these pay by securing survival.

BODY-CELLS AND GERM-CELLS.—The next step in the evolution of sex was the confirming of what forms like *Volvox* began—the setting apart of special reproductive cells as distinguished from the somatic cells. In a developing embryo we see a process of division of labour, whose structural result is called differentiation. Some cells become contractile and some sensitive, some digestive and others skeletal, and so on, but some do not share at all in body-making—and these are the germ-cells that continue the race.

What we see beginning in *Volvox* is established in almost all multicellular organisms, from sponge and polyp to bird and mammal, from seaweed and liverwort to fern and tree—namely, sexual reproduction, the continuance of life by means of special germ-cells. In many cases it is combined with asexual reproduction by buds or fragments, and the difference between the two methods must be carefully considered.

ADVANTAGES OF SEXUAL REPRODUCTION. The question thus arises: What are the advantages of the liberation of special germ-cells as against the process of budding, or of fragmentation where a considerable sample of the body is set adrift? (a) An obvious answer is that the method of sexual reproduction—starting a new organism from a fertilised ovum—is much more economical than the asexual process. In the one case two cells suffice to start a new organism; in the other cases thousands of cells may be required. There is something in this answer, but it cannot be the complete one, since many plants

and many of the lower animals feed so easily that economy is not of any account. A single Hydroid polyp developed from a fertilised ovum soon builds up asexually a great colony of thousands of individuals. It must also be remembered that the economy of sexual as against asexual reproduction is in many cases only apparent—the wastage of germ-cells being frequently enormous. (b) A second suggestion is that asexual reproduction is incompatible with the complex organisation of a higher animal. We cannot think of a bird multiplying by fission or of an elephant giving off a bud! They are too highly differentiated. No piece of a higher animal could serve as a representative sample of the whole, as an excised piece of polyp does. The possibility of keeping pieces of tissue alive after excision from the body is very much greater than was formerly supposed, but a separated piece of a higher animal is not in natural conditions viable. Now there is doubtless good sense in this suggestion, but it cannot be the complete answer. This must be granted when it is noted that some very complex organisms give off buds, witness the bulbils of the tiger-lily, a highly evolved flowering plant, or the remarkable buds of the beautiful free-swimming Tunicates known as Salps. The Salp is a very intricate animal, with a much specialised body, and yet it alternates reproduction by germ-cells with reproduction by budding. This is effected by means of a reproductive “stolon”—a shoot-like outgrowth containing prolongations from most of the important organs in the

body and becoming eventually separated into a chain of buds. In other words, a means has been evolved whereby an animal with a complex body may continue to produce buds, just as simple polyps do. (c) The third suggestion is that the distinction between germ-cells and body cells would justify itself in leaving a free course for the differentiation of body cells (as nervous, contractile, glandular, and so on), and in securing that the reproductive cells were in some measure at least sheltered from the influences of the accidents and incidents of bodily life. Reproduction by special germ-cells obviates or lessens the risk, attendant on asexual reproduction, that the offspring share in the acquired bodily defects of the parent. Of course it must likewise operate against the transmission of extrinsically acquired bodily gains. On the other hand, the important constitutional gains which begin as germinal variations are more or less securely entailed by the germ-cell method, in virtue of what is called the continuity of the germ-plasm (see our *Evolution*, p. 114). Variations are indeed common among asexually produced plants, as we see at a Chrysanthemum show, but the germ-cell method is even more productive. Some recent work suggests that the nutritive and other environment of the young germ-cells within the body may serve to provoke germinal variations, acting in fact as "liberating stimuli." Thus the risk of transmitting bodily defects is lessened, while the supply of heritable changes of endogenous origin is increased. Another advantage probably lies in the fact

that the commencement of the new individual life at the level of a single cell means an ever recurrent re-unification of the inheritance. For no one can think of the germ-cell as like an ill-packed portmanteau with a higgledy-piggledy of hereditary items: it is a living creature in a condensed form, an individuality with a unified organisation. So far, then, an answer to the question: In what respects is sexual reproduction an improvement on asexual reproduction?

SPERM-CELLS AND EGG-CELLS.—The next step was also a confirmation of what some form like *Volvox* began—the definite establishment of dimorphic germ-cells or gametes. One type of germ-cell was relatively large, with a good deal of cytoplasm (or general cell-substance) in proportion to nucleus, provided with some store of nutritive material, and therefore sluggish—the Ovum. The other type of germ-cell was relatively small, with little cytoplasm in proportion to nucleus, with very little reserve material, and therefore predisposed to move towards nutritive substances, to explore—the Spermatozoon. This evolution of dimorphic gametes, with anti-thetic but complementary qualities, was an echo of the macro- and micro-spores of some Protozoa, but there was, without doubt, a fresh start made when animals with a “body” came upon the scene.

In most animals the infinitesimally minute and intensely active spermatozoa seek out the ova which, though often invisible to the unaided eye, are relatively large. The spermatozoon is often only $\frac{1}{100000}$ of the size of

the ovum. In the flowerless plants, such as ferns and mosses, there are actively locomotor spermatozoa or antherozoids (see Fig. 6), but though there long seemed to be no intermediate step between this and the seeming

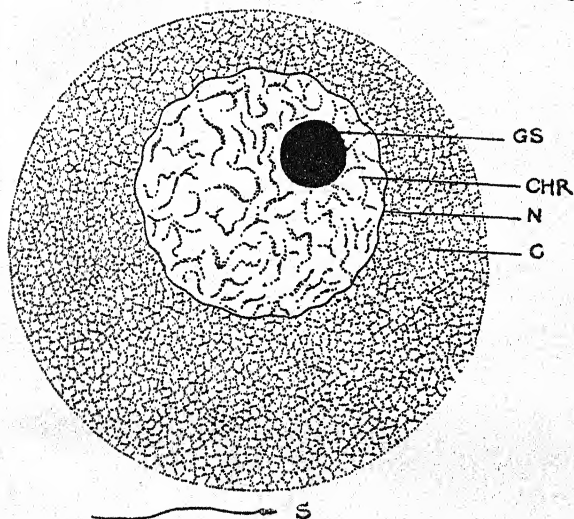


FIG. 5.—Ovum and spermatozoon (S) of a sea-urchin, alike magnified over 750 times, showing relative size. (After E. B. Wilson.) The ovum shows the cell-substance or cytoplasm (C) with an intricate structure, the nucleus (N) with readily stainable bodies known as chromatin threads (CHR), and with a nucleolus or germinal spot (GS).

static pollen grain of higher plants, a mobile spermatozoon has been found to emerge from the pollen tube in certain cycads, and also in the strange Gingko or Maiden-hair Tree brought to our gardens from the temple enclosures of old Japan. And the pollen-

grains of ordinary flowering plants, although they correspond to the whole male generation, and usually abbreviate away the formation of spermatozoa in adaptation to the loss of watery environment, are adapted to passive

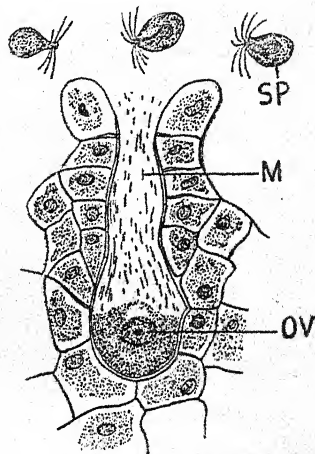


FIG. 6.—Female reproductive organ or archegonium in the Adder's Tongue Fern—*Ophioglossum*—and the motile male cells or antherozoids (SP). The egg-cell is marked OV; it lies in a flask-like recess, the neck of which shows a mucous secretion through which the male cells make their way. (After Bruchmann.)

transportation, from blossom to blossom, by the wind or by the agency of insects (Fig. 7).

To the question why the dimorphism of germ-cells should have been justified in the course of evolution, two answers may be given. (a) A number of facts point to the general conclusion that cross-fertilisation is advantageous. Darwin first clearly showed—

and despite some exaggerations his general conclusion survives—that the progeny of cross-fertilised plants are more successful and

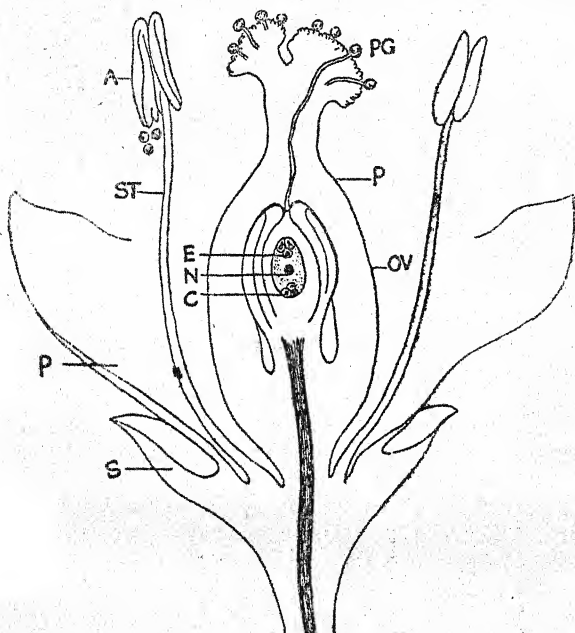


FIG. 7.—Diagram of a flower. S, sepal; P, petal; ST, stamen with anther (A) liberating pollen grains; P, pistil; OV, ovary enclosing an ovule which shows an embryo-sac with the egg-cell (E), the endosperm nucleus (N), and the antipodal cells (C); on the stigma are seen several pollen-grains (PG) whose pollen-tubes are growing down the style towards the egg-cell. (After Sachs.)

more fertile than those of similar plants self fertilised. Now cross-fertilisation will be more readily secured if one of the germ-cells be

specialised as a locomotor element. Were both locomotor, as in some Protozoa, the likelihood of cross-fertilisation would be greater still, but the egg would not then be so well adapted in the way of providing the initial material for development and some nutriment as well. As for the condition seen in most Crustaceans and in Nematode worms, where the sperms are sluggish, and amœboid rather than flagellate, the males have to make up for the loss of activity on the part of their spermatozoa, by directly bringing these into close proximity to the ova. (*b*) The other advantage of division of labour among the germ-cells is that the one which is to undergo development after fertilisation by the other can be safely endowed with a legacy of yolk, can be ensheathed within envelopes which protect the delicate embryo, or can be hidden away in safe places within the mother's body and there undergo development. Thus, looking backward, we may justify as great steps in evolution the specialisation of egg-cells and sperm-cells (see Fig. 5).

SIGNIFICANCE OF FERTILISATION.—In most animals large numbers of ova are produced, and in many cases only a small percentage are fertilised. Inconceivably large numbers of spermatozoa are produced, but all die, except the small minority that reach the ova. In all but a few cases the spermatozoon and the ovum that unite in fertilisation come from different parents; for although there are many hermaphrodite (bisexual) animals, *e. g.* snails, earthworms, leeches, pairing none the less occurs, in fact, of two-fold nature, simul-

taneous or successive. There remain rare cases, such as some of the parasitic flukes and tapeworms, in which there is self-fertilisation (autogamy), the ova being fertilised by spermatozoa from the same individual. The sperms may reach the ova after these have been laid, as in the case of salmon; or just as they are laid, as in the case of frogs; or within the body of the female, as in all reptiles, birds, and mammals. It is evident, therefore, that the sexual union which leads to "insemination" and which from observation of the higher animals long seemed to be the very essence of the process, is really of later acquirement. The gist of fertilisation throughout life remains as the union of two sex-cells, however that may be accomplished. It may be noted that artificial insemination has been successfully effected in some of the higher animals, such as sheep, cows, mares, white mice, and hens. The spermatozoa can be kept for some time in weak salt solutions.

What does fertilisation imply? (1) It implies an intimate and orderly combination of the paternal and maternal inheritances, which are probably borne in greater part by the nuclear elements or chromosomes of the spermatozoon and ovum respectively, and in some measure also by the extra-nuclear protoplasm of the two germ-cells. (2) During the maturation of the spermatozoon and ovum, the number of chromosomes (which is always definite for each kind of organism) is reduced to half the normal, so that fertilisation restores the normal number. (3) Besides bearing the paternal contribution to the

inheritance of the offspring, the spermatozoon also introduces a minute body known as the centrosome, which plays an important part in the subsequent division of the fertilised ovum. (4) It is also certain that the spermatozoon acts as a stimulus which sets the egg dividing—or, it may be, removes some inhibiting factor which was keeping the egg from dividing. In a variety of cases what the sperm does, whether in stimulation or in removing a check, can be replaced artificially, and this in many different ways. The experiments of Loeb, Delage, and others have shown that the ova of starfish, sea-urchin, worm, mollusc, fish, and even frog can be made to divide without being fertilised. Alterations in the chemical and physical state of the medium, *e. g.* the addition of a little magnesium chloride to the sea-water, may replace ordinary fertilisation, at least in so far as setting division agoing is concerned. The artificial stimuli effectively used are very varied—physical, chemical, and mechanical—an electric shock, a superabundance of carbonic acid gas, and even a pinprick. They differ for different kinds of eggs, and even for eggs of the same kind at different stages of ripeness. Perhaps there is some common factor in all the effective stimuli, but what it is remains unknown. According to some experimenters, the egg responds directly to the external stimulus; according to others the artificial conditions do not directly induce segmentation, but modify the intimate condition of the egg in such a way that it becomes auto-parthenogenetic. The second view is suggested by cases in which the

egg does not begin to segment until some time after it has been restored to its natural medium. (5) Lastly, it is probable that, in some cases at least, fertilisation irrevocably determines the sex of the offspring into which the fertilised ovum will develop.

Looking backwards, we see that fertilisation involves great waste of life-material. It must therefore have some great advantage. When we consider the five things above indicated as involved in ordinary fertilisation, we may notice that sex is sometimes determined quite apart from fertilisation and previous to this, that a stimulus to division may be effected by some artificial change, that the ovum has originally a centrosome of its own which it might conceivably retain, and so on. In short, there can be little doubt that the chief significance of fertilisation is to be found in the first two implications. There is a mingling of two inheritances, which may favour variations and also counteract them; and there is a restoration of a certain norm of nuclear constitution subsequent to a remarkable process of reduction. In this reduction there is a notable opportunity for variation, since the number of chromosomes is reduced to half the normal. Suppose the chromosomes in the nucleus of an unripe egg were represented by a pack of cards, the process of maturation (usually the giving off of the first polar body) involves a literal loss of half of the pack. The normal number is restored by the addition of another half-pack borne by the fertilising spermatozoon.

Green-flies or Aphides produce prolifically

all through the summer, without there being any males in existence at the time; the eggs in a bee-hive that are not fertilised develop into drones; in some of the wheel-animalcules or Rotifers the males have never been found; the same is true of some of the gall-flies; and there are numerous parthenogenetic plants. The question is, therefore, pertinent—Why is fertilisation the rule, seeing that many creatures get on very well without it. The probable answer must be that fertilisation is of profound racial significance—in affording an opportunity for new departures and in tending to secure a holding fast of that which is good.

MALES AND FEMALES.—The next step in the evolution of sex above the clear differentiation of egg-cell and fertilising element is that of two distinct types of individual—the sperm-producer and the ovum-producer, the male and the female. In *Volvox* we may find the same colony producing numerous ova and numerous sperms, and other colonies producing only ova or only sperms. The hermaphrodite or bisexual organisms that occur at many levels in the animal kingdom and are so common among Plants, represent in part a pristine condition, and in part a secondary incorporation of one sex by the other—in most cases, it may be, an acquisition of femaleness by males.

The fundamental problem is to account for the evolution of two kinds of individuals within the species—the sperm-producers or males and the egg-producers or females; and our view (developed many years ago in *The Evolution of Sex* (1889), and briefly applied in

our *Evolution* in the present series) is that the difference between the sexes expresses the same kind of constitutional alternative that we see in the contrasts between spermatozoon and ovum, between animals and plants, between active Infusorians and sluggish Sporozoa, in fact between the free and the sedentary groups which recur at so many levels of the animal kingdom, and in short between preponderant activity and passivity in all forms of life.

The first step, at least, in the scientific explanation of a phenomenon is to show that it is a particular case of a general sequence, and our theory of sex interprets the difference between male and female as an instance of a primeval and ever recurrent alternative in variation—namely, between increased expenditure and increased income; between relative predominance of disruptive, analytic, down-breaking processes, on the one hand, and a relative predominance of constructive, synthetic, up-building processes, on the other hand; between, to put it shortly, a relative preponderance, to the extent of constitutional bias, of one or other of these katabolic and anabolic processes which all physiologists agree are mingled in the life of protoplasm and cell, tissue and organ. The resulting bias of this whole life-process, this ever-mingled metabolism, is thus for us expressed in sex and its subvarieties (themselves, as almost every family shows, preponderatingly accented one way or other), but also in the contrasts of allied species and genera, of families and classes, sub-kingdoms and kingdoms. Sex

and variation are thus deeply one, and the variations on which Natural Selection operates are thus fundamentally dichotomous.

Granted the advantage of cross-fertilisation and of dimorphic sex cells, it seems clear that, other things being equal, those species would get on best which exhibited two distinct constitutions or forms, sperm-producers and egg-producers. As the difference became defined—the expression, we maintain, of a continually recurrent dichotomy—it would doubtless react on the sex-cells. More effective ova would be produced by the more anabolic females, and more effective spermatozoa by the more katabolic males.

Returning to *Volvox*, we see that some of the cells in the ball become large, well-fed ova; others, less anabolic, fade from green to yellow, divide and re-divide into many minute units—the spermatozoa. The large cells or ova of one colony are fertilised by the small cells or spermatozoa of another colony. The formation of dimorphic reproductive cells may be seen going on in different parts of the same colony, but it often happens that the spermatozoa are formed first and the ova later—which is like a temporal division of the sexes. In other cases the eggs are formed first. Or we may find *Volvox* balls in which only ova are produced, or only sperms—the sexes being separate. The former seem to be more vegetative and nutritive than the latter, and we are at the foundation of the divergence between the sexes. Occasionally, moreover, ova are produced which develop parthenogenetically. In fact, this primitive organism,

with its asexual, hermaphrodite, unisexual, and parthenogenetic forms, is a very epitome of the evolution of sex.

TESTES AND OVARIES.—In a sponge, which shows no organs in the strict sense, and only the beginnings of tissues, the germ-cells appear sporadically in the middle stratum (or mesogloea) of the body, and both sperms and ova may be seen developing in the same sponge. An important step was taken, however, when the formation of gametes began to be localised and when these foci of gamete-making began to be enclosed, protected, and nourished by adjacent tissue. At first, doubtless, the difference between the egg-multiplying gonads (or ovaries) and the sperm-multiplying gonads (or testes) was only to be detected with the microscope, though it was very profound. But gradually there came about a specialisation of the accessory parts in relation to the deeply different functions of egg-multiplying and sperm-multiplying, and recognisably different ovaries and testes were established. Furthermore, there came to be associated with ovaries and testes a good deal of auxiliary tissue that had nothing directly to do with oogenesis or spermatogenesis. Accessory glands and ducts were formed.

It is probable that variations or mutations involving the tissue in the vicinity of the reproductive organs have been from time to time caught up into their service, and it is not necessary to suppose that these advantageous accessions, such as having a yolk-gland near the ovary, arose as pure coincidences. For it is a well-known fact (whether

we understand it or not) that variations are often correlated. It seems as if one germinal change may have several inter-linked effects.

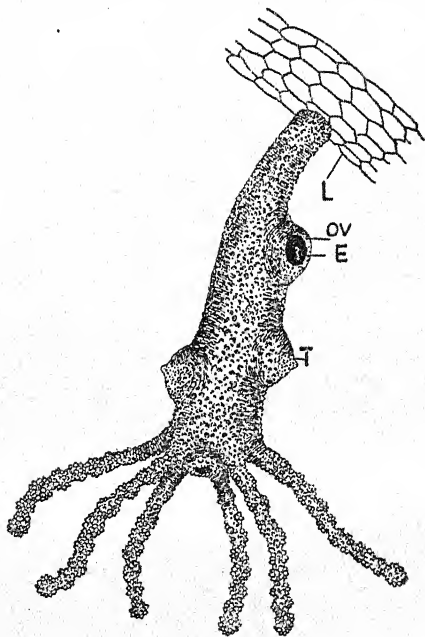


FIG. 8.—The freshwater polyp, Hydra, hanging down from a leaf (L). It is about half an inch in length. The diagram shows the tubular body; the tentacles around the mouth; the male organs or testes (T) in very simple expression as minute knobs of cells; the ovary (OV), a protruding nest of cells with one ovum (E).

This idea requires to be extended to the body as a whole. A somatic character, which to begin with had nothing to do with sexual reproduction, may come into its service, and

be more or less changed in connection with its new function. Some investigators, such as Tandler and Grosz and Kammerer, have gone the length of maintaining that all sex-characters have arisen from the transformation of species-characters. "Just as in the primitive Metazoon body the cells lying next the gametes came by change of function into the service of reproduction, so it may have been that more distant cell-complexes, which had already reached some degree of structural differentiation and subserved other functions, suffered partial or even total loss of their original function, and became auxiliary to reproduction."

SEX DIMORPHISM.—In many of the simple backboneless animals, the two sexes are practically identical in appearance, and exhibit no definite sex-behaviour. Thus without a microscope it is often impossible to tell a male starfish from a female, or a female from a male sea-urchin. Nor can we see that the one sex is attracted to the other. The fertilisation of the eggs is more or less haphazard, but it must be noted that large numbers of individuals are found living together, and that the males and females become mature about the same time. Both ova and spermatozoa are set adrift in the sea, and as there are thousands of sperms for every ovum the chance of fertilisation is much greater than would at first sight appear likely. Moreover, from within a short distance there is a "chemotactic" attraction of the spermatozoa to the ova (see Fig. 9).

It should be noted that animals like sea

urchins with superficially similar sexes are none the less in a sense very sexual, at the breeding season at least, for they produce enormous quantities of eggs and sperms, and the reproductive organs are huge in proportion to the body. Thus one of the British starfishes (*Luidia ciliaris*) produces at least 200 millions of eggs.

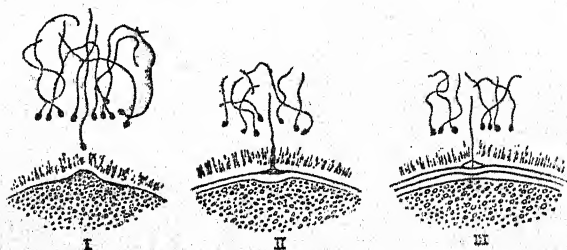


FIG. 9.—Fertilisation of ovum of starfish—after Fol. In I the spermatozoa are seen surrounding the ovum, which is enveloped in a delicate zone of mucus. A minute "receptive cone" is seen on the surface of the ovum. In II a spermatozoon is entering, the locomotor tail is seen protruding, a membrane is being rapidly formed around the ovum. In III the spermatozoon has entered, the membrane is completed, the ovum has become non-receptive. Only a small part of the ovum is shown.

As we ascend the series, the evolution of sex-dimorphism becomes gradually apparent. Following the differentiation of tissues and structures accessory to the reproductive organs the body itself begins as a whole to be sexed. Various structures, quite extra-genital, begin to have alternative expressions, more or less mutually exclusive, and masculine and feminine individuals thus at length appear. Animals began to put on secondary sex

characters; and this was the great step of sex-dimorphism. It need hardly be said that in this we find every conceivable grade of contrast.

Besides the divergence in structure, there is a functional contrast between male and female. In face of the extraordinary variety of the Animal Kingdom, generalisation has its hazards; but, on the whole, we may say that the male tends to more intense metabolism, to more exuberant expenditure of energy, to live a keener but shorter life, to have much less expensive reproduction, to be more impetuous, combative, and experimental, and to be the more divergent from the youthful and the ancestral type. Yet the female is not, therefore, necessarily the less evolved, since her relative nearness to the ancestral stock, her less accented specialisation, her persistent youthfulness may also carry with it the very promise of the race. Hence in fact the divergent types of masculine and of feminine beauty in our own species, the former more strongly individualised, but the latter by common consent more humanised, and thus more adapted to the expression of the ideals of racial and of social evolution. Biology and art, mythology and poetry are thus not the separate cultures we conventionally regard them, but correlated aspects of the ascent of life.

SEX-AWARENESS. — Another step in the evolutionary ladder is represented by those animals which show sex-awareness, which give distinct evidence that the presence or proximity of one sex acts as a stimulus to

the other, leading, primarily or ultimately, to the liberation of the sex-elements. When this is the case, fertilisation is more likely to be secured. As an example of this still very lowly plane of sex-attraction, where there is no sexual union, but where proximity or contact is the liberating stimulus provoking a discharge of germ-cells, we may take the familiar case of the salmon. The female fish makes a furrow in the gravelly bed of the river and lays her eggs there; the attendant male is stimulated by the presence of the ripe female and by the presence of the eggs to liberate the sperms or milt upon them. No doubt many of the thousands of sperms are lost forthwith, but what occurs is an improvement upon the primitive and wasteful broadcast semination of the waters.

It remains, however, certain that in the lower reaches of the animal kingdom where no sex-behaviour exists, the fertilisation of the eggs is more or less haphazard. This involves the production of large numbers of ova and huge numbers of sperms, which we interpret as implying: (1) that simple organisms are naturally very prolific, and (2) that a survival bonus was persistently awarded to those members of a species that were constitutionally most prolific. The constitutionally prolific survived, while the constitutionally non-prolific would tend to be eliminated.

We would dwell for a moment upon this necessarily great productivity of germ-cells on the part of simple animals, because it seems to us that it became a widespread constitutional characteristic in many lines of

evolution, and lasted long after the necessity for it was past. Perhaps even man has thus to pay for his long pedigree, for the over-production of both eggs and sperms, though relatively moderated as compared with lower animals, still remains a main difficulty of individual and of social life, albeit also a potent factor in their progress.

PHYSICAL FONDNESS.—A further step is represented by those animals which show the

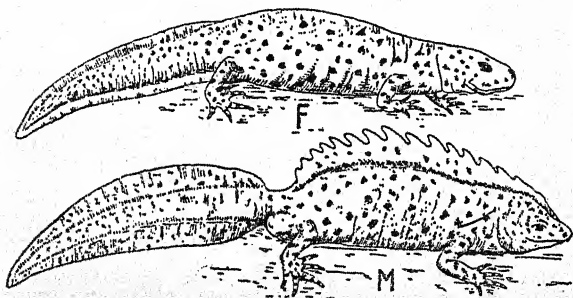


FIG. 10.—Crested Newt—Triton or *Molge cristatus*. M, the male with a scalloped dorsal median fin; F, the female without a crest. They differ greatly in coloration.

beginnings of sex-behaviour. The note of physical fondness is sounded. In diverse forms there is a courtship of touch, often prolonged and not without its refinements. The male may play with the female, caressing her, it may be dancing before her. Some of the newts illustrate this grade of behaviour, the males touching, fondling, and embracing the females, and doubtless thereby fanning the fire of sexual excitement (see Fig 10). The case is of especial interest since there is no

pairing in the strict sense. The male deposits the sperms in minute packets or spermatophores—which adhere to stones in the water, and the female passes these into her body.

ÆSTHETIC ATTRACTION.—The next step is made when to the primary tactile courtship there is added a variety of æsthetic appeal. We may well say variety, for it is a long gamut that includes the song of the nightingale and the trumpeting of the elephant, the croaking of frogs and the instrumental serenading of the cicadas, the drumming of the snipe and the tapping of the death-watch on the wainscot. There are displays of other gifts—of strength, agility, and beauty, for the blackcocks hold a tournament before their grey hens, the cock-of-the-rock has an excited dance, and the Argus pheasant displays his hundred eyes. Some of the glow-worms attract their mates by flashes of light, some butterflies by their fragrance. In short, to the physical fondness of one sex for another there is added a more or less elaborate æsthetic fringe, and not the least interesting point is this, that there is scarce a thread of this embroidery that has not been caught up and sublimed in the subtly woven cords of human love.

Let us take the interesting picture that Prof. Emery has given us of the Italian fire-fly (*Luciola italica*). The females sit among the grass while the males fly about in search of them. When a female catches sight of the flashes of an approaching male, she allows her splendour to shine. He sees the female's signal, and is swiftly beside her, circling round

like a dancing elf. But one suitor is not enough. The female attracts a levée. In polite rivalry her devotees form a circle and await the coquette's choice. In the two sexes, Emery says, the colour of the light is identical, and the intensity seems much the same, though the love-light of the female is more restricted. The most noteworthy difference is that the luminous rhythm of the male is more rapid, with briefer flashes; while that of the female is more prolonged, with longer intervals, and more tremulous—illumined symbols of the contrast between the sexes. The female *Luciola* sits surrounded by her suitors; flashes of light come and go; finally a choice is made and the party breaks up. Whatever the luminescence may mean physiologically in the constitution of the insect, it seems to be a love-signal between the sexes.

It is confessedly very difficult to prove that the courtships of animals are associated with emotions analogous to ours, but in many cases there are visible manifestations similar to those which accompany emotion in ourselves. To refuse to believe that the exuberant song of birds is associated with joyousness is a sternness of scepticism for which we are not prepared. In many cases, apart from any immediate gratification of sexual desire, the mates look as if they liked one another. They pine when they are separated; and if they are not pleased to be reunited, they have an extraordinary power of behaving and looking as if they were.

CO-OPERATION OF THE SEXES.—Yet a higher grade is illustrated by those animals which

work together, and remain associated for a considerable time—it may be for life. It is true of many birds that the cock and the hen unite their energies in building the nest and in providing for the young; the cock often takes his share or more than his share of brooding; some are faithful to one another for a season; others, like the eagles, mate for life. The story of the hornbills has been often told. The female lays an egg within a hollow tree; the male closes up the entrance with resinous material until only a small slit is left; he feeds her through this opening day after day until he is as lean as she is fat. The egg is hatched, but the male, as Mr. Pycraft tells us in his fine *History of Birds* (1910), “is reduced to a mere skeleton, so lowered in vitality that on a sudden fall in the temperature, such as takes place after rain, he not seldom falls down exhausted and dies.” It is unnecessary to beg any questions by calling this behaviour self-sacrifice, but it cannot be gainsaid that the male spends himself in a manner which is objectively other-regarding.

In Mammals also we find examples of lasting partnerships on a monogamous basis, where, as it seems to us, animal love reaches its highest level, surviving the excitements of the reproductive period, steadying itself in the wider sympathy which is at once the condition and the result of practical co-operation, broadening itself, too, in its altruism as it laps the family in its folds, surviving even its dispersal.

LOVE.—The differences between man and

the animals are not less important than the resemblances, and as man has come to himself the complex attraction which we call love has been in proportion heightened and deepened and sublimed. As man emerged—a rational creature in some measure conscious of his instincts and his aims, capable of controlled conduct as a social person, all things became new, including love. While the deep organic impulse remains as a legacy from a remote past, while the elements of physical fondness and æsthetic attraction are not lost without impoverishment, while practical partnership remains all but indispensable, there are undoubtedly new elements, notably of intellectual and ethical sympathy, and the self-consciousness of it all which is expressed in the sentiment of love.

At the same time it cannot but seem either strangely unobservant or pharisaic when men or women resent any analogy between animal love-making and their own. We may trade with our legacy, but we cannot refuse it, and it is not inconsistent with recognising human love as a new synthesis to observe that strands, both coarse and fine, which are prominent in lower forms of life have been caught up and utilised in man. From another point of view, this also should be said, that it is well for us to take admiring knowledge of the artistic character of many animal love-makings, for they put man's often too rough-and-ready manners to utter shame.

CHAPTER III

SEX-CHARACTERS ILLUSTRATED

Classification of sex-characters—Illustrations of sex-characters—General impressions—The general contrast.

SINCE the beginning of the present century the difficult problem of the origin, development, and evolution of sex-characters has been illumined by a series of brilliant experimental researches, which have made a reconsideration of the whole subject imperative. This has been facilitated by the masterly work of Kammerer, who has gathered together the most important data and submitted them to an analysis at once fair-minded and critical.

CLASSIFICATION OF SEX CHARACTERS.—At many levels in the animal kingdom there are marked differences between the males and females of a species—so marked in some familiar cases that different popular names are applied to the two sexes (*e. g.* cock and hen, ruff and reeve, stag and hind), so marked in some unfamiliar cases that zoologists have unwittingly named as different species what were afterwards recognised to be but male and female of a single form. When the differences between the sexes are well marked we speak of sex-dimorphism.

The contrasted characters that go to constitute sex-dimorphism are of different kinds. They may concern the essential reproductive organs—the ovaries and testes of female and male respectively, which, though

arising in the same way in the embryo, may come to be so different that even on external inspection the two sexes can be distinguished at a glance. Thus in most Mammals the testes are carried in an external pouch or scrotum (into which they descend, as if by a sort of normal rupture, at a certain stage in development), while the ovaries always remain internal.

In the second place, the dimorphism may be expressed in conspicuous differences in the accessory reproductive organs, such as egg-laying structures or ovipositors in the females and organs for effecting sexual union in the case of the males. Thus every one knows that drone-bees have no sting, for a sting is a transformed ovipositor turned to a new use, and is therefore confined to the queen-bees (functional females) and the worker-bees (usually sterile females). A male spider is clearly marked off from his mate by the extraordinary transformation of the tips of the second pair of mouth-parts—the pedipalps—into organs which are used in transferring the fertilising spermatozoa into the female.

In the third place, the dimorphism may be expressed in peculiarities, like antlers, manes, combs and spurs, which have nothing directly to do with reproduction, but which the males have and the females have not. In a number of less familiar cases, the female has structures which are conspicuous by their absence in the males, though in these cases it must be confessed that the males are more or less degenerate. Thus many a male Rotifer has no food-canal, and the male of a remarkable

marine worm called *Bonellia* is a pigmy parasite on its mate (see Fig. 11).

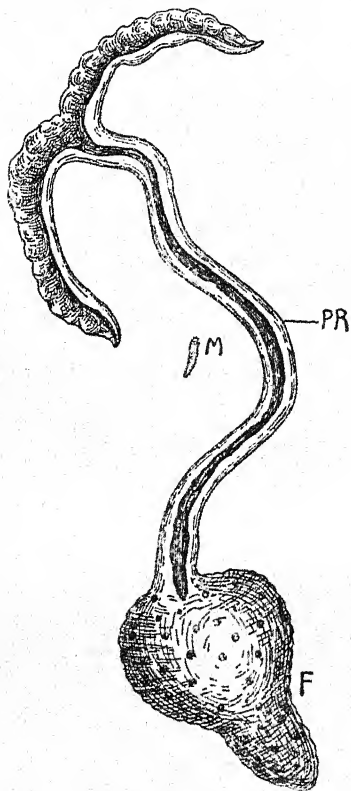


FIG. 11.—The peculiar green worm *Bonellia viridis*—the female (F) with a long retractile bifid grooved proboscis (PR), and the pigmy male (M). (After Lacaze-Duthiers.)

Fourthly, the dimorphism may find expression not in any peculiar structures or

peculiar transformations of structures, but in a more diffuse way—affecting the size (females being usually larger), the proportions of parts, the colour (males tending to be more brilliant), and other features, or in numerous little ways giving a slightly different turn to the analogous organs in the two sexes.

It is usual to classify the differences between the sexes as “primary” and “secondary,” to which some would add “tertiary.” The “primary” differences refer to the reproductive organs, the “secondary” to those that appear in other parts of the body, such as the larynx or the hair. A clearer scheme of division, slightly modified from Poll’s and Kammerer’s table, may be thus expressed—

SEX DIFFERENCES

I. ESSENTIAL.

In the gonads—ovaries and spermaries.

II. ACCESSORY OR INCIDENTAL.

- (a) Subsidiary to the gonads :—
internally, as in accessory glands;
externally, as in pairing or egg-laying organs.
- (b) Somatic and extra-genital :—
internally, as in vocal organs;
externally as in colour, hair, feathers, etc.

It is evident that most of these sex-differences have both a structural and a functional side, a morphological and a physiological aspect; but for practical purposes one side may often be disregarded. Thus a chitinous decoration or instrument on a male beetle

has no vital activity after it is once formed; it is the structural side that is important. On the other hand, the differences in the blood of a male and a female, which have been shown to be of profound importance, may not have any detectable structural expression. Similarly, there are many subtle differences in instincts and impulses, in physiological habit, and in length of life, which are very real though we cannot say much about their structural expression.

Another consideration that must be kept in mind in the classification of sex-differences is the degree of permanence in their expression. An adult peacock can never be confused with a peahen, but there are many birds, *e. g.* some ducks, which show great dissimilarity between the sexes at the breeding season and great similarity at other times of year. In many fishes, such as sticklebacks, the males are conspicuously different from the females at the breeding time, but inconspicuously different at other times. In short, there are many nuptial characters which wax and wane according to the sexual state of the organism.

ILLUSTRATIONS OF SEX-CHARACTERS.—Convenient surveys of sex-differences are to be found in Darwin's *Descent of Man* and in Cunningham's *Sexual Dimorphism*. For our purpose, we do not require more than a few typical cases. Among mammals illustrations abound. The male gorilla is larger and stronger than the female, with more powerful canine teeth, and with a well-marked crest along the top of the head, which is absent in

his mate. The mandrill has, again, enormous canines, and the bony prominences of the upper jaw which rise on each side of the elongated snout, are covered with blue naked skin, with ridges and furrows; the canines, the prominences, the furrows and the colouring are much less marked in the females. The male elephant seals of Kerguelen's Land have an inflatable nasal proboscis, the free part of which projects for six inches; and the bladder-nosed seal of the North Atlantic ice-fields has the base of the nose dilated on the dorsal side to form a bladder which can be blown up till it is as big as the head. The male narwhal has its canine tooth on one side produced into a spiral tusk which may be ten feet long; its fellow on the other side normally remains about ten inches long; in the female both are rudimentary. Stags have their antlers, but in the reindeer these occur in both sexes. Those of the female are smaller and less branched, and she retains them till she bears her young in April or May, whereas the male loses his, as usual, immediately after the breeding season (at the end of November). Darwin noted that the antlers appear in both sexes very early, in fact, in four or five weeks after birth, whereas it is not usual for stags to have antlers till their second summer. According to some authorities, when Cervidæ began to have antlers, they were specific characters shared by both sexes; they have become secondarily restricted to the males (except in reindeer). But according to others, the antlers were, to begin with, restricted to the males, and

have become secondarily the possession of the female reindeer. It is difficult to decide between these rival views. To explain the possession of antlers by the female reindeer, Cunningham refers to the fact that the females use them as weapons and that the older females often lead large herds of young males and females. In cattle, sheep and goats, the horns usually occur in both sexes; in antelopes, they may be confined to the males, as in kudu and saiga, but in most cases, *e. g.* eland and oryx, they occur in both sexes; in the aberrant pronghorn of the Rockies the horns are rudimentary in the female. The long curved tusks of the wild boar, the exaggerated tusks of the babirusa, the tusks of the Indian elephant, the spur on the hind-leg of the duckmole and the echidna are other well-known masculine features.

Among Birds sex-dimorphism reaches a climax in the birds of Paradise, the humming-birds, and the game-birds. In the males it is common to find specially decorative feathers which can be erected and displayed to the best advantage. Every one knows the magnificent tail feathers of the peacock, the wing feathers of the Argus pheasant which are raised to form a circular fan, the curved outermost tail feathers of the blackcock, the brilliant tufts and elongated tail feathers of many humming-birds, the decorations of the birds of Paradise, which baffle description, the remarkable tail of the lyre-bird, and the long neck feathers of the ruffs.

Besides more decorative plumage the male bird often exhibits other distinctive features.

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The cock has his spur and larger comb and wattles; the prairie cock has an inflatable bare orange-coloured sac on each side of the neck; the turkey-cock has his large spur, and the fleshy process on his forehead, pendulous but erectile, is larger than in the female; the male huia of New Zealand has a short, strong and nearly straight bill, while that of the female is much longer, more slender, and curved; the great bustard has an inflatable throat pouch at the breeding season.

In Reptiles sex-dimorphism is not usually striking, but there are some good illustrations among lizards. The male of the American chamæleon (*Anolis*) has an erectile crest along the back and tail, and some male chamæleons have bony projections in front of the eyes. Among Amphibians the male newts have more brilliant colours and crests on their back and tail, but only, it is said, in those species in which the male does not clasp or embrace the female. In male frogs and toads there are often swollen cushions or pads on the hand, which are of service in grasping the female. In some cases, as in the common edible frog of the Continent, the male has resonating sacs formed as pouches from the lining of the mouth, and in *Rhinoderma darwinii* these are much enlarged and form a receptacle for the eggs! The eggs laid by the female are taken by the male into his mouth and pass to the sacs where they develop into small frogs. In *Noto-trema*, a tree-frog of tropical America, there is an interesting occurrence of a structure peculiar to the female, namely, an egg-pouch

on the back. It is formed by an invagination of the skin from behind forwards, and into it the male pushes the eggs with his hind feet.

Among fishes the sexes are often very like one another, but there are many illustrations of sex-dimorphism. In some gristly fishes or Selachians, like the skate, the males have very conspicuous "claspers." They are specialised parts of the pelvic fin, have a complex musculature and skeleton, and are entirely wanting in the females. In the male *Chimara*, these parts are even more complicated, and "on the head there is further a remarkable knobbed and curved spine projecting forwards, and covered at its extremity with sharp denticles. There can be no doubt that this also is used for holding the female, although the exact mode in which it is used has not been observed" (Cunningham).

The male salmon has the tip of the lower jaw turned up and enlarged at the breeding season. It forms a curious blunt hook-like process, which is possibly of use when the males charge one another. In many cases, such as lumpsucker and stickleback, which are as contrasted types as one can think of, the males are distinguished at the breeding season by the brilliant colouring. In the male sea-horse (see Fig. 12) and some of its relatives, the most striking sex-distinction is the possession of a pouch in which the eggs develop. It is noteworthy that in the genus *Solenostoma*, the pouch is in the female, which is more vividly coloured and spotted than the male. Perhaps she has to attract her mate!

There is among insects an embarrassing

wealth of instances of sex-dimorphism. Male butterflies and moths are often more brilliant

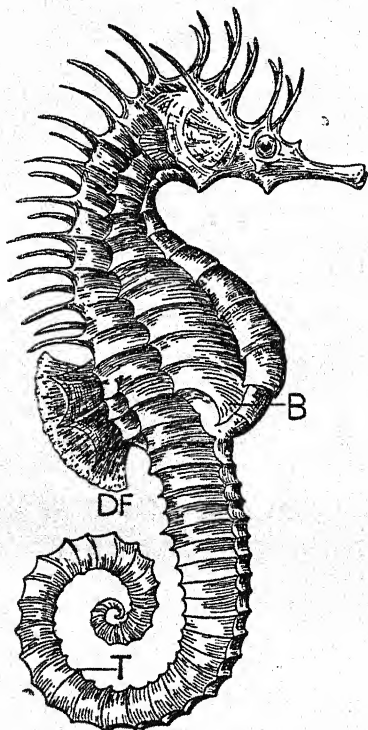


FIG. 12.—The Sea-horse—Hippocampus. A male, showing the brood-pouch (B) in which the eggs are carried, the prehensile tail (T), and the rapidly vibrating dorsal fin (DF).

and decorative than the females, but the reverse is sometimes the case, and, more commonly still, the sexes are similar. The

males have often more elaborate antennæ and other sense-organs, which are important in finding the female. Among the Dynastid beetles the males often have extraordinary horn-like projections from the head and

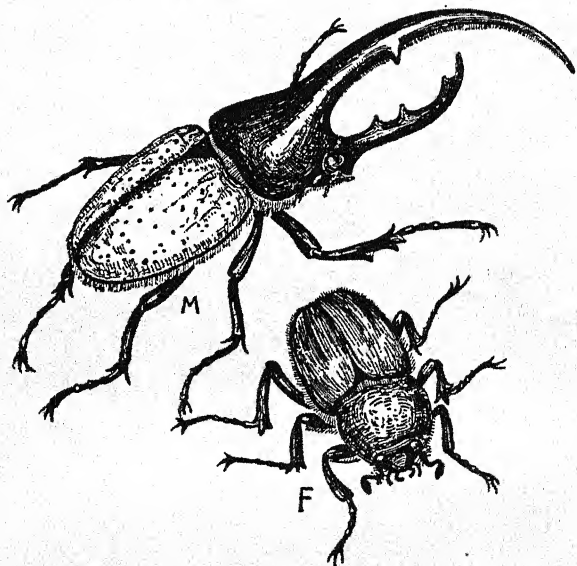


FIG. 13.—The Hercules Beetle—*Dynastes*. In the male (M) a horn on the back of the head works against a still larger horn arising from the top of the prothorax. The female (F) is smaller and without the horns.

prothorax (see Fig. 13). They are outgrowths of the chitinous cuticle and cannot be moved of themselves, though they may be brought together like the limbs of tongs when the head and the prothorax are moved. Their use is uncertain. In the stag-beetles

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(Lucanidæ) the mandibles of the males are sometimes as long as the body, and, like the antlers of stags, they often seem to be very much in the way. Darwin called particular attention to the great differences in the degree of development of the male excrescences in beetles, some species having them in extraordinary exuberance while others show no dimorphism to speak of. In some cases, as in many moths, the female beetles are sluggish and have no wings. In the glow-worm (*Lamproyrus noctiluca*) the males have well-developed wings and very large eyes; the female has smaller eyes and no wings. Among spiders, the males are often pigmies compared with their mates, and often much more brilliantly coloured. It has been calculated that the disproportion of size is sometimes such as would be observed if a man 6 ft. high and 150 lb. in weight were to marry a giantess of 80 ft. in height and 200,000 lb. in weight (see Fig. 2).

Among Crustaceans sex-dimorphism is common, even if we do not take into account the extraordinary cases in which the female is parasitic and the male free-living. One of the most striking cases is that of the giant crab (*Macrocheira*) of Japanese waters, where the male has huge forceps many times longer than the body, while the female is very much smaller and has the forceps unexaggerated. Many male crustaceans have specially developed clasping organs and are often larger than their males. Every one knows the common Gammarus of the shore, where the male is much larger and stronger than his

mate, whom he carries about with him for prolonged periods. In some of the acorn-shells there are pigmy males.

In the other divisions of the Animal Kingdom there is little illustration of sex-dimorphism. The male cuttlefish often has a peculiarly modified "arm" which becomes a receptacle for sperms and is liberated into the mantle cavity of the female. In the paper nautilus (see Fig. 17) we have one of those exceptional cases where the female has a positive character which is unrepresented in the male: she has two of the arms remarkably modified and a very beautiful shell used as a cradle for the developing eggs. The male is much smaller and shows no hint of an external shell (see Fig. 18).

Mr. Cunningham has directed attention to some examples of sex-dimorphism among worms. In some marine Polychætes, *e. g.* species of *Nereis*, both sexes become extraordinarily changed at sexual maturity—so much changed that mature forms have been placed in one genus and immature forms in another. There may be an alteration in the shape and size of the locomotor appendages, in the form and number of the bristles, and in the size of the eggs and tactile structures. But the point is that these alterations are different in the two sexes, being more pronounced in the males. In the Japanese Palolo worm the females are deep green above and greenish-yellow below, while the males are light greenish-yellow above and pinkish-white below.

We may conclude this survey with mention

of Bonellia, an interesting green worm with a flask-shaped body an inch or two in length and a flexible bifid proboscis much longer (see Fig. 11). But this is the female, for the male is only about a hundredth of her size and lives as a parasite within the oviduct. It is one of the most extraordinary cases in the whole Animal Kingdom. The microscopic male embryos after swimming freely by means of cilia, attach themselves to the proboscis of a female, pass down to the gullet, and eventually to the oviduct. They have not even a mouth, and are little more than minute bags of sperms.

There is very little sex-dimorphism among Echinoderms, but a very curious case is reported by Koehler, an authority on the group, who states that the males of one of the brittle-stars, *Ophiacantha vivipara*, have five arms, while the females have always more (six to eight).

GENERAL IMPRESSIONS.—Taking a retrospect, we notice that in most cases the positive character is on the male side. He has an extra something which the female does not possess in a developed state, if at all. It is important therefore to recall two or three examples of the converse. The females of the frog genus *Nototrema* have a pocket on the back into which the male pushes the eggs. So far as we know the marsupium is never more than a rudiment in male marsupials. In the red-necked phalarope the female is the more decorative bird. Drone bees have not the sting which the queens and workers possess.

We should also note, after a survey of sex-characters, that conspicuous difference between the sexes is the exception, and general similarity the rule. In many of the higher animals the males and females are very like one another in external appearance. Cat, mouse, rabbit and hare, may be mentioned among mammals; rook, kingfishers, and many parrots among birds. Below the level

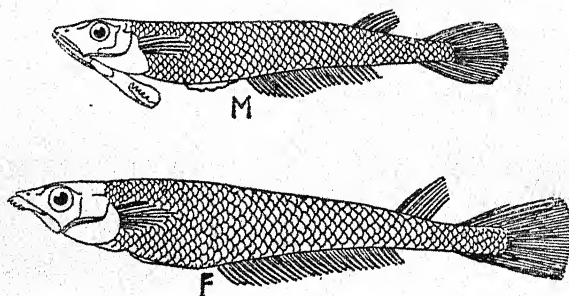


FIG. 14.—The sexes in a small fish—*Phallostethus dunckeri*. The female (F) is the larger. The male (M) bears a relatively large intromittent organ projecting below the gill-cover. (After C. Tate Regan.)

of crustaceans, in animals like starfishes and sea-urchins, marine worms, thread-worms, jellyfish and corals, it is rare to find more than minute sex-dimorphism.

THE GENERAL CONTRAST.—Contrariwise, although there may not be any marked dimorphism, there may be a profound functional difference. There are many facts, long since summarised in *The Evolution of Sex*, which go to show that the metabolism of the male and the female are very different.

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They live at different physiological rates; the metabolism of the male is relatively more intense. The ratio of katabolism to anabolism is greater in the male than in the female. We may quote a few sentences from another biologist, who expresses the same view. In his *Sex Antagonism* (1913), Mr. Walter Heape writes: "The Male and the Female individual may be compared in various ways with the spermatozoon and ovum. The Male is active and roaming, he hunts for his partner and is an expender of energy; the Female is passive, sedentary, one who waits for her partner and is a conserver of energy."

Perhaps the average differences between the sexes may be summed up tentatively in this tabular contrast—

MALE.

Sperm-producer.
With less expensive reproduction.
More intense metabolism.
Relatively more katabolic.
Often with shorter life.
Often smaller.
Often more brilliantly coloured and more decorative.
Rising to more intense outbursts of energy.
More impetuous and experimental.
More divergent from the youthful type.
Often more variable.
Making more of sex-gratification.
More combative.

FEMALE.

Egg-producer.
With much more expensive reproduction.
Less intense metabolism.
Relatively more anabolic.
Often with longer life.
Often larger.
Often quieter in colour and plainer in decoration.
Capable of more patient endurance.
More persistent and conservative.
Nearer the youthful type.
Often less variable.
Making more of the family.
Consolidating the family.

CHAPTER IV

THEORY OF SEX-DIMORPHISM

Darwin's theory—A Lamarckian theory—Physiological theories—The rôle of internal secretions—Sex-changes in crabs—Specific characters and sex-characters—Difficulty as to origins—Suggestion as to the mode of origin of sex-characters.

DARWIN'S THEORY.—As every one knows, Darwin proposed a theory of sexual selection to account for the frequent occurrence of secondary sex characters, such as are familiar in cases like stags, stag's-horn beetles, peacocks, and birds of Paradise. On the one hand, he pointed out, there are the combats between rival males which tend to leave those with less perfect weapons or less ability to use them without their fair share in parentage. On the other hand, there is preferential mating, in the course of which the female chooses or seems to choose the more decorative, or agile, or melodious, or otherwise attractive suitor, thus tending to increase these gifts and graces in the hereditary equipment of the race, as far at least as the male sex is concerned.

There is considerable difficulty in regard to the facts of the case. Where the weaker males, worsted in combat, are killed, or expelled from the herd, or left unmated, the elimination may be reasonably interpreted as tending to raise the standard of those qualities in virtue of which the successful males succeeded. In some cases, however, it is stated that the males unfortunate in war are lucky in love. Much depends on the

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relative numbers of the sexes, and many of the alleged cases of great numerical disparity have been shown to be fallacious.

The late Alfred Russel Wallace was a persistent critic of the theory of sexual selection, pointing out, for instance, that there is little convincing evidence that the female bird really chooses her partner, or chooses him because of any particular excellence in colour or plumage, song or dance. Contrariwise, some ornithologists maintain that in some species certain males are left definitely unmated, and that they are inferior in attractiveness. In the mysterious case of spiders, where the courtship is often elaborate, the fastidious female sometimes kills a suitor who does not adequately please her; as well as afterwards, it may be, the one who does. By that time, however, the latter has had some measure, at least, of success in reproduction and in thus handing on to his progeny his meritorious qualities. So that his death is of less moment to the race. Many of the illustrations of sexual selection which Darwin gave remain very convincing, but the theory requires to be strengthened by more precise evidence that considerable numbers of the less attractive or less well-equipped males are either left unmated, or have less numerous and less successful families as the result of their matings. The theory may be consistently improved by recognising what some students of comparative psychology have indicated, that the female probably surrenders herself not to a male selected because of some particular excellence, but rather to the one whose

ensemble most successfully excites her sexual interest. In some passages Darwin seems to credit the female with a high degree of taste or æsthetic fastidiousness; he was doubtless on safer ground when he wrote, "it is not probable that she consciously deliberates; but she is most excited or attracted by the most beautiful, or melodious, or gallant males." A useful suggestion has been made by Groos that the displays of the excited suitors—displays often more reflex than controlled—have the effect of infectiously exciting the female and of overcoming her coyness, a character which is of no inconsiderable racial value. An easily excited, readily persuaded female type would not make for racial stability.

The difficulty that a particular quality of the male could not be augmented by selection without also affecting the corresponding character in the female progeny of successive generations, will be discussed later, but we may point out that although a quality passes into the inheritance of both sexes, the conditions of development may prevent it finding expression except in one sex.

Another difficulty is raised by the fact that there are some cases of pronounced sex-dimorphism where there is no evidence either of preferential mating or of combats. Subsidiary hypotheses have been invented to meet these cases, such as Wallace's that Natural Selection would tend to eliminate females that were conspicuous during incubation, or Günther's that masculine characters have their justification as a means of "bluffing" enemies.

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Perhaps the most serious difficulty is that some of the modern experimental work in regard to selective breeding is beginning to shake the confidence with which many have held the Darwinian view that marked augmentations can be accounted for by the gradual accumulation of minute increments generation after generation. It may be that such selection as is afforded by combats and preferential mating is quite inadequate to build up slight fluctuations into extraordinary differentiations like the stag's antlers and the peacock's tail.

A LAMARCKIAN THEORY.—In his interesting *Sexual Dimorphism*, J. T. Cunningham argues in support of a Lamarckian interpretation: "In either sex unisexual characters have, as a general rule, some function or importance in the special habits or conditions of life of the sex in which they occur." "But the important truth, which appears to have been generally overlooked, is that in the case of each special organ its special employment subjects it to special, usually mechanical, irritation or stimulation, to which other organs of body are not subjected. Every naturalist and every physiologist admits that in the individual any irritation or stimulation, regularly repeated, produces some definite physiological effect, some local and special change of tissue in the way of either growth or absorption, enlargement or decrease, or change of shape. Thus not only hypothetically at some former time, but actually at present in every individual, the unisexual organs or appendages are subjected in their

functional activity to special strains, contacts, and pressures, that is, to stimulation, which must and does have some physiological effect on their development and mode of growth." To explain the restriction of sex-characters to one sex, to the period of maturity, and often to one period of the year, Cunningham supposes that "heredity causes the development of acquired characters for the most part only in that period of life and in that class of individuals in which they were originally acquired." Unisexual characters are largely of the nature of excrescences which originated from mechanical or other irritation in the male or the female at particular times and in particular states of body. They are now part and parcel of the inheritance, but they are not expressed in the body except in association with physiological conditions the same as those under which they were originally produced.

Cunningham seeks to show that sex characters may be legitimately interpreted as the hereditary outcome of special irritations. The legitimacy of this interpretation depends (1) on the experimental evidence that can be adduced to show that callosities, excrescences, proliferations, etc., do arise as the direct result of stimulation; and (2) on the case that can be made out, on experimental or on logical grounds, for believing that somatic modifications may be directly transmitted in some degree at least. This raises the whole question of the transmission of somatic modifications, which are acquired by the individual as the direct result of peculiarities

in function or in environment. We have considered the pros and cons at some length elsewhere, and it appears to us that the seriously discussible evidence on the affirmative side is not sufficient to warrant an acceptance of Cunningham's position, at any rate without the considerable degree of restatement which the Lamarckian theory requires—though again it is to be admitted that this re-statement is in progress and on various sides, as from Semon to Bergson.

A PHYSIOLOGICAL THEORY.—Professors Hesse and Doflein have made the interesting suggestion that, as reproduction is commonly of much less organic strain to males, they have so far a surplus of plasmic material and vital energy at their disposal, which may account for their frequently greater variability, for certain characteristics of habit and temperament, and for exuberant growths of various special kinds.

To the objection that the male is often much smaller than the female, and that his nutritive income is proportionally less, the answer is that the decisive fact is one of ratio, *e. g.* between the amount of material used in reproduction and the weight of the body in the two sexes, or between the size of the reproductive organs and the size of the body in the two sexes.

In cases where the sexes expend approximately equal amounts of material in reproduction, almost no sex differences occur. Thus in many fishes, such as the herring, the ovaries and testes are about the same size, and enormous quantities of milt are shed

by the males in the water. In the viviparous Cyprinodonts, on the other hand, where there is internal fertilisation and economy of sperm-material, the males show both permanent and periodic distinguishing features (see Fig. 14).

In his critique of this "surplusage theory," Kammerer indicates some serious, and indeed fatal, objections. (1) It may explain how the male has a good deal to spare on decoration, but it sheds no light on the specific line that his disposal of the surplus takes—a mane for the lion and antlers for the stag. (2) It is easy to pick out cases that suit the theory, but what of the broad fact that in hundreds of cases among birds and mammals, reptiles and insects, the two sexes are equal in size, equal in numbers, and uniform in appearance, although the expenditure on the male's side remains very much less than on the female's? (3) The female's reproduction is more expensive, yet it is the female that tends to fatten. And why is it that when her reproductive expenditure is over, her accessory sex-characters do not improve (except in rare cases), but become less marked than ever? (4) There are many cases where the male has to fertilise the eggs of many females, and where he has no masculine peculiarities, which is what the theory would suggest. But there are also many cases of a similar sort, where the polygamous male, like peacock, pheasant, stag, bull, sea-lion, shows an exuberance of masculine features. Indeed it may be argued that increased sexual function in the male tends to increase the masculine features, and *vice versa*.

THEORY OF SEX-DIMORPHISM 79

Another physiological theory was put forward by the authors in 1889 in *The Evolution of Sex*, where it was maintained that the deep constitutional difference between the male and the female organism, which makes of the one a sperm-producer and of the other an egg-producer, is due to an initial difference in the balance or rhythm of chemical changes. That is to say, the two sexes differ fundamentally in the life-ratio of anabolic to katabolic changes. In the female, the balance of income and outlay, of constructive to disruptive changes, is the more favourable one; the anabolic process tends to have relative preponderance, and this profit may be devoted to growth, and towards offspring, in producing which she hence can afford to bear the larger share. In short, the life-ratio of anabolic to katabolic changes, $\frac{A}{K}$, in the female is normally greater than the corresponding life-ratio, $\frac{A}{K}$, in the male of the same species. Now it would be crude to suppose that structures like yolk-glands or milk-glands are the direct outcome of the relatively greater anabolism of the female. Nor can greater exuberance of integumentary structures and more abundance of pigmentation in them be regarded as the necessary outcome of the relatively katabolic male constitution. But it may be that masculine and feminine secondary sex-characters are on the whole congruent with the kind of constitution which implies maleness and femaleness respectively. Whether a character in the germinal inherit-

ance finds expression or not may depend on whether the organism is male or female in its fundamental metabolism; and similarly what degree of expression a particular character finds opportunity for in development may be determined in the same way.

THE RÔLE OF INTERNAL SECRETIONS.—It has long been recognised that the reproductive organs exert a pervasive influence on the body, as is conspicuously seen in the changes that occur at adolescence, and in pregnancy, even in remote parts of the body. The fact is expressed in Helmont's aphorism: "*Propter solum uterum mulier est, quod est,*" which Chereau changed into "*Propter solum ovarium mulier est, quod est.*"

The view of Pflüger, that the gonads exert an influence through the nerves associated with them has given place to the view, originating with Brown-Sequard, that the influence passes into the body by the medium of the internal secretions of the gonads. To Starling we owe the convenient term "*hormones*" for the specific stimulating substances in these internal secretions, and more recently Schäfer has given convincing illustrations of their subtle and multifarious efficacy within the organism.

It may be explained that a male organ or testis in a higher animal consists of sperm-making cells arranged in tubules, of interstitial cells of various types, the whole within an outer envelope of connective tissue. Similarly the female organ or ovary consists of ova disposed in groups of follicles, of interstitial cells of various kinds (the stroma of

the ovary, the follicle cells, and the corpus luteum), all within the sheath of connective tissue.

It has been shown by many investigators that the interstitial cells of the mammalian testis possess a relative independence of the germinal portion. They may be well developed at a time when the germinal part is still embryonic; they may occur at some distance from the seminiferous tubules; they may be normal in old testes from which the sex-elements have disappeared, or in diseased testes in which only the seminiferous part is affected. Three functions have been assigned to the secretion of these remarkable glandular cells, that it is nutritive for the testis, that it acts as a formative stimulus for the secondary sex-characters, and that it affects genital excitement.

It has also been shown that masculine characters (*e. g.* in the horse and in man) may develop although the sperm-making part of the testis is degenerate, so long as the interstitial tissue remains well developed. It follows that the stimulating internal secretion, without which the masculine characters do not develop, is produced by this interstitial tissue. In mole, marmot, man and other mammals, the interstitial tissue waxes and wanes, and the recurrence of "heat" in animals is preceded by activity of the interstitial tissue before sperm-making activity sets in. Similarly in the female, the internal secretions that pass from the ovary have their origin, not in the germinal, but in the interstitial part of the organ.

Let us consider the case of fowls. For three or four weeks after hatching, chickens do not show any external marks of sex. In size and colour of comb, in plumage and limbs, pullets and cockerels are alike, and it is not till towards the thirtieth day that the external differentiation begins to be apparent. By the forty-fifth day the comb is more pronounced and more vividly coloured in the male; the wattles begin to develop; the young cocks crow towards the second month; differences in the plumage begin to differentiate the two sexes more and more sharply.

So far we are on familiar ground, and it is also well-known that the removal of the testes hinders the development of the secondary sex-characters. But a recent investigation by J. des Cilleuls has made matters more precise. He has shown that the appearance of the secondary sex-characters in the young cock coincides with the appearance of interstitial cells in the testes; that the interstitial cells and the distinctively cock-characters increase concurrently; and that the cock-characters continue to be accentuated till after the sixtieth day, while the essential part of the testes—the seminal tubules—remain embryonic. It would appear therefore, that the internal secretion of the interstitial cells serves as a stimulus for the development of the secondary sex-characters.

A great number of very interesting experiments have been made in reference to the rôle of the internal secretions in connection with sex-characters, and while there seems to be a tendency to hurry to very definite

conclusions while the investigation is still very young, it seems legitimate to say that in many cases the diffusion of the internal secretion throughout the body serves as the liberating stimulus evoking the development of sex peculiarities which have hitherto remained latent or unexpressed. It must not be supposed that the internal secretion from the gonads causes the sex-characters, though it may be a condition of their normal development in the individual. The gonads are the nurses of the secondary sex-characters, but not their producers. The sex-characters were in the hereditary treasure-box, even though not exhibited. But it is certainly very remarkable that even when a gonad is absent, the secondary sex-characters lying latent may be called into some measure of expression by an injection of the secretion.

SEX-CHANGES IN CRABS.—It was the French zoologist Giard who first called attention to the extremely interesting phenomenon which he called "parasitic castration." Many young crabs, *e. g.* of *Stenorhynchus*, are infested by other Crustaceans of the family Bopyridæ, which become mature at the time when their hosts should also be mature. But the gonads of the crab have been destroyed by the parasite, and a remarkable change has been brought about. If the crab be a male it exhibits some of the structural features of a female, it loses its masculine impulse and it actually defends its parasite as a female does her eggs, the parasite protruding on the outside of the tail just where a female crab carries her eggs. It used to be remarked as

very curious that only female crabs were attacked, but Giard showed that many of the apparent females were parasitised males. If the victim be a female, there is no change of structure or of instinct, except that she cherishes the parasite instead of eggs—which are absent.

Giard's work has been extended by that of Geoffrey Smith, in a series of researches remarkable for their thoroughness. In the case of male crabs of the genus *Inachus*, for instance, he found that castration, brought

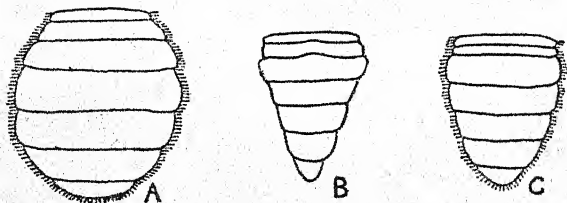


FIG. 15.—Forms of Abdomen in a crab, *Pachygrapsus*. A, of a female; B, of a male; C, of a parasitised male approximating to the female type. (After Geoffrey Smith.)

about by *Sacculina* and the like, induced a very striking expression of latent feminine and female features. The crab developed egg-carrying abdominal limbs like those of a female and it produced eggs. The normal crab is not in any sense a hermaphrodite, but the effect of castration is the development of the latent characters of the other sex.

Potts has studied the castration of male hermit-crabs by *Peltogaster* and of male shore-crabs by *Sacculina*. In the former, the male characters persisted; in the latter, though the castration was incomplete, some

female characters appeared. Smith and Potts are both of opinion that what happens is a change of the metabolism of the crab on to female lines. In *Inachus*, the putting on of external feminine characters preceded the appearance of the ovaries, so that the theory of a specific secretion passing from the gonads to the body is in this case excluded.

Smith's theory has an important bearing on the significance of sex and on the rôle ascribed to internal secretions. Without going into technicalities, let us seek to understand more precisely what he means by saying that the parasite disturbs the general metabolism and that this affects the expressions of sex. In a normal female crab the ripening ovary takes up lutein and fat; this seems to stimulate the liver to make more, and to lessen another of its functions, namely, making glycogen (or animal starch) which is used in growth. In the ripening female the blood becomes progressively charged with fat and lutein, and this might be described as the distinctively feminine condition of the blood. Now the roots of the *Sacculina* penetrating through the male crab affect the metabolism just as an ovary does in a female. They take up fat and stimulate the liver to make more. The glycogenic function is depressed, for there is an absence of demand for glycogen, there being no growing or moulting after the *Sacculina* has protruded on the under side of the crab (see Fig. 16). It has not been shown that the male's blood is actually charged with lutein and fat, but the liver is always coloured with lutein, and so are the

Sacculina roots, showing that a transference of these materials has occurred, perhaps so rapidly that their presence in the blood cannot be detected.

Smith's view is in general that the parasite alters the composition of the male's blood to

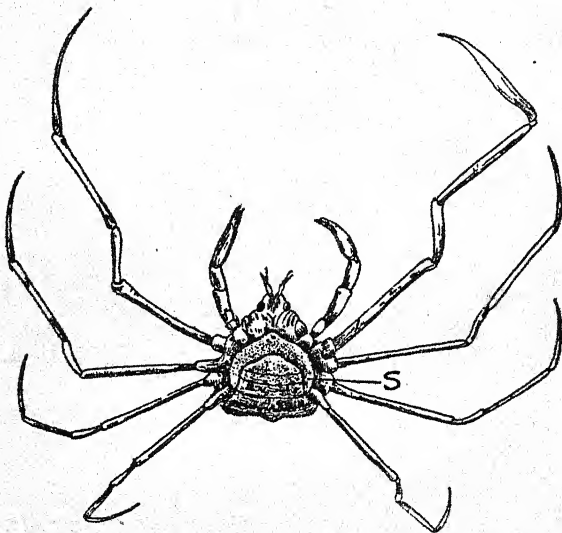


FIG. 16.—Male crab *Inachus* with the sac-like parasite, *Sacculina* (S) protruding between the under surfaces of the abdomen and the cephalothorax. Forceps and abdomen modified towards female type. (After Geoffrey Smith.)

or towards a female condition, and that this is naturally followed by the development of female secondary characters, or by the regeneration of an ovary instead of a testis from the indifferent germ-cells that remain at the end of infection. In short he would supple-

ment the rôle of hormones by recognising the importance of metabolism-stimulation.

Using the terminology of *The Evolution of Sex*, Geoffrey Smith says of the adaptive regulation of the metabolism in the parasitised male crab that "this adaptive regulation consists in the production of at least a partially female condition of metabolism as opposed to a wholly male condition, the female condition being preponderantly anabolic or conservative, as opposed to the katabolic male condition, and by this change from a katabolic to a more anabolic condition the animal can withstand better the drain on its system increased by the parasite."

SEX-CHARACTERS AND SPECIES-CHARACTERS.—The interesting thesis has been already mentioned (Tandler, Kammerer, Tandler and Grosz), that sex-characters have been derived from ordinary species-characters, which have been brought into special correlation with the reproductive organs and their internal secretions. Tandler writes: "All secondary sex-characters were indeed at first specific characters . . . and not primarily associated with the genital sphere." Thus the milk-gland has doubtless arisen from a group of sebaceous glands, common to both sexes. Later on, it underwent transformation, and in the female, came into the service of another function, and under the influence of the gonads. There is no puzzle in the fact that it is represented in an undeveloped state in the male.

Kammerer comes to the same conclusion: "The sex-characters simply form a particular group of species-characters: all sex-characters

are at the same time species-characters." In this connection he refers to Möbius's thesis that there is a sort of somatic sex, a sex-differentiation of all the organs and tissues, whether they show a visible difference or not, so that one may, he notes, invert the previous sentence and say that all species-characters are also sex-characters. But, in any case, there are certainly no special sex-characters, which stand apart from other species-characters, as things *per se* and autonomous.

In their recent work Tandler and Grosz are very emphatic in their conclusion that all sex characters have been derived from specific characters or "systematic" characters, which in the course of time have been brought (by the usual method of variation and selection) into the service of reproduction. This occurred at different periods, as is suggested by their different degrees of variability to-day. And in the course of their evolution they have come into correlation with the gonadal glands of internal secretion which supply in a remarkable way their indispensable liberating stimuli. "The secondary sex-characters are, to begin with, systematic characters and they ultimately owe their development and differentiation to the harmonious co-operating of the glands of internal secretion."

The thesis that: "All secondary sex-characters were at first specific characters," appears to us to be an exaggeration of a sound idea. There are, it seems to us, numerous peculiarities of one sex or the other which cannot be readily derived from specific characters supposed to be common to both sexes.

And if it be said that the cases we would adduce are not fair samples of sex-characters, we would reply that it is very difficult to draw a line round "secondary sex-characters," separating them from other sex-differences. This is especially difficult among invertebrate animals where we have little knowledge of glands of internal secretion connected with

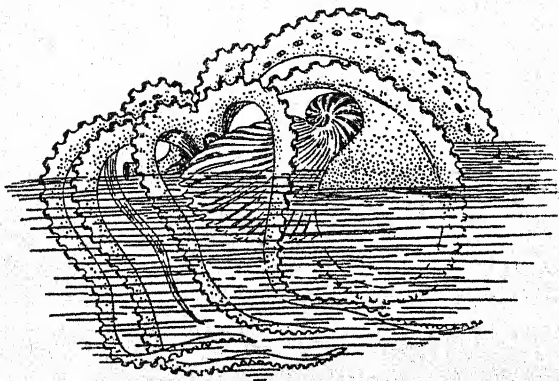


FIG. 17.—Female of Paper Nautilus—*Argonauta argo*—with its brood-chamber shell, enveloped by the expanded ends of two of the arms.

the essential gonads, and are therefore bereft of that useful criterion of a secondary sex-character which has been discovered in vertebrates.

Let us consider, then, a few striking sex-differences in their bearing upon Tandler's theory. The female paper-nautilus, or argonaut, is very different from the male. She is much larger, she has two "arms" peculiarly modified to secrete a unique shell, not homo-

logous with other cephalopod shells, which is used as a brood-chamber for the developing ova (see Fig. 17). The small male has no such shell and no such modification of two of the arms. When he is sexually mature, one of his arms becomes laden with sperm-packets and is discharged as a "hectocotylus" into the mantle cavity of the female (see Fig. 18).

These are familiar facts, but we do not

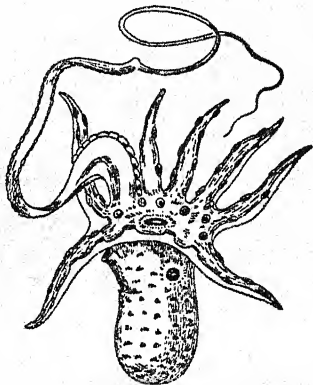


FIG. 18.—The minute male of the Paper Nautilus—*Argonauta argo*—showing the mouth surrounded by eight arms, one of which has been "hectocotylised," i. e. much specialised for reproduction. The locomotor funnel and the mantle opening may be seen to the left, one of the eyes to the right. Twice natural size. (After Müller.)

know of any evidence for supposing that the ancestors of the argonaut ever had an external shell of the argonaut type or modified arms such as the female now shows. There is no hint of such a thing. Moreover, the shell is not for living in, but for the protection of the eggs; it is a cradle, not a house, and it

has no meaning except in the female. Unless indeed one supposes that both sexes used to carry the eggs, or that the ancestors of Argonauta were hermaphrodites—but for any such hypotheses, there are no bases.

Let us take one of those very interesting cases where the female has something definite and positive which the male has not—the frog *Nototrema* with its dorsal pouch in which the eggs are carried. Is there any warrant for supposing that this was once a specific character? Another case in point may be found in the so-called claspers of male Selachians. In a fish like the skate they are very conspicuous sex-characters; they are highly specialised structures with complicated musculature and skeleton. They are very definitely male organs, without any representation in the female. There is no warrant for supposing that the ancestors of our modern Selachians had structures like these claspers in both sexes, or even rudiments of them.

Again, in most mammals, though the ovaries always remain internal, the testes are carried in an external pouch or scrotum into which at a certain stage of development they descend, as it were by a rupture normalised. This is a definite male peculiarity, a specialisation not necessarily present; it is not hinted at in the female; and again there is no warrant for regarding it as a transformation of any specific character ever common to the two sexes. In the same way the protruding egg-sacs of many female water-fleas, *e. g.* *Cyclops*, are extra things on the female's part.

DIFFICULTY AS TO ORIGINS.—Darwin's

theory of sexual selection suggested that a variation in male animals in the direction of, say, better weapons or more beautiful plumage, would be profitable to its fortunate possessors. They would be more successful than others in reproduction and their stock would prevail; those of their kin who had not the excellence in question would be sooner or later eliminated. If the facts bear it out, the theory is a sound interpretation of the survival of certain characters. But it did not pretend to explain the origin of the variations assumed to have occurred, and it is this question of origins which makes all our evolutionary inquiries difficult alike.

At this point the Lamarckian interpretation has theoretically the advantage, for if males acquired weapons as a direct organic response to fighting, and decorations as the organic reward of doing their best in the way of showing themselves off without them, or as the result of functional changes in the blood-pressure and in the distribution of the blood-vessels, then the problem of origin is solved. And if these individual acquisitions are entailed on the offspring, then the problem of their becoming racial characters is also solved. But, as we have already hinted, there are great difficulties in the way of this interpretation.

If we pass to the suggestive view that distinctive sex-characters are all derivable from specific characters by a change of function and by becoming correlated with the reproductive organs, whose internal secretions supply the physiological nexus, then

the problem of the origin of the sex-characters is not different from that of the origin of any of the species-characters. We have, indeed, to assume that in the course of time the species-character varied in rather a novel way, but it seems to have been a common thing in the course of evolution that an apparently new organ should arise by a transformation of a very old structure. Thus the spinnerets of a spider are very novel contrivances, but they represent transformed abdominal limbs; the serpent's fangs are folded or channelled teeth, and its reservoirs of venom are specialised glands of the mouth and lips; a bird's feather is part of a reptile's scale glorified; and the hammer and anvil that form part of the delicate apparatus for conveying vibrations from the drum to the inner ear were once part and parcel of the rougher and more commonplace mechanism of the jaws. There is abundant analogy, then, in support of the view that ordinary species-characters may be transformed into sex-characters. But the origin of the transformation remains obscure. Moreover, there are many sex-characters which cannot be traced back to specific characters common to the two sexes. Finally, care must be taken not to invest the internal secretions with more than a trigger-pulling and quantitative influence.

Having cleared the ground, we come back to the vague proposition that sex-characters arise as germinal variations. Here, it may be, we are up against a fundamental character of organisms, that they continually tend to vary and often to vary creatively. But let

us not treat this characteristic as if it were altogether and hopelessly mysterious. Without straying far from our present path, we may recall some of the possibilities. Fluctuations in the nutritive stream may evoke responsive changes in the germ-cells. The opportunities afforded in maturation and fertilisation may bring about a shuffling of the chromosome cards. External changes may serve as variational stimuli to the highly complex germ-plasm.

Going deeper, perhaps, we recall what Spencer, for instance, emphasised, and what the progress of chemistry since his day has made even more vivid, the tendency in matter to complexify. Perhaps the living unit, which we know as the germ-cell, utilises this complexifying tendency in a progressive differentiation of its own. It is important at all events to remember that a sex-cell is not an ordinary detached cell, it is a gamete, an individuality condensed; and just as an intact organism from *Amoeba* to *Elephant* tries experiments, so it may be that the implicit organism of the germ-cell tries experiments—which we call variations.

SUGGESTION AS TO MODE OF ORIGIN OF SEX-CHARACTERS.—Let us suppose that a germ-cell already predisposed to develop into a female is the seat of a variation in the hereditary constituent corresponding to the future ovary. Let us suppose that this variation is in the direction of producing an accessory yolk-gland. In the course of development the variation, if consistent with the rest of the constitution, is actualised and

there is the beginning of a yolk-gland—an advantageous addition obviously. In the course of time the organism reproduces and its germ-cells have entailed on them (in accordance with the conception of germinal continuity) the primary constituent (determinant or factor) of a yolk-gland. But the difficulty immediately arises in the mind that this new hereditary item will be found not only in the germ-cells which will develop into females (where it will be relevant), but also in the germ-cells which will develop into males (where it will be irrelevant). The question, then, is what will happen to the yolk-gland determinant in those germ-cells that are going to develop into males. The answer is that it will remain latent, not because its expression would be irrelevant, but because it arose as a variation in a germ-cell predisposed to develop into a female. It is solidary with femaleness, which, for us, means a metabolism-ratio or rhythm with relatively preponderant anabolism. Metaphorically, it is a seed which will germinate in female soil, which will not germinate in male soil, though it will remain latent there.

For the sake of clearness, let us take the same occurrence on the male side. In a germ-cell (whether ovum or spermatozoon, or fertilised ovum), predisposed to develop into a male—*i.e.* a sperm-producer, a variation arises, say, in the direction of brilliant pigmentation of the skin. If it is consistent with the rest of the organisation, it is realised in development, the spermatozoa have it entailed on them, and it is transferred to a

multitude of ova. But it develops only in those fertilised ova which are going to develop into males. It does so develop because it was to begin with a variation—a new departure—made by a male-producing gamete. It is a seed which can germinate only in a male soil, which will remain latent in a female soil. Thus a germinal variation in the parthenogenetic ova of bees, which develop into drones, will be unexpressed in the queens, but none the less faithfully handed on by them.

We suggest, then, the hypothesis, that distinctively masculine characters arose from variations in gametes predisposed or predetermined to develop into males, that distinctively feminine characters all arose from variations in gametes predisposed or predetermined to develop into females, and that this primal difference in origin explains (1) why the new gains are often confined in their expression to one sex, and (2) why they hang together in an hereditary congeries. The hypothesis is in no wise inconsistent with the view that many sex-characters are transformed species-characters, for the new departure in such cases was the transforming. Nor does the hypothesis conflict in the least with the facts in regard to the importance of hormones in the individual development of the sex-characters, which is a question in the physiology of development. Nor does the hypothesis conflict at all with the view that some process of selection favoured the persistence and diffusion of the new character. Nor does the hypothesis conflict at all with

the view that the sex-characters behave in inheritance as Mendelian characters. The hypothesis concerns the origin, not the development, or the evolution, or the mode of inheritance.

One of the arguments that may be used in support of our hypothesis is that used in a slightly different connection in *The Evolution of Sex*. It is this. There are numerous distinctively masculine characters which have some measure of "family resemblance," which look as if they had something in common, which are congruent with the intenser metabolism of the male sex. To a thorough-going Lamarckian this is readily intelligible, for he regards the colour-display, the exuberance of integumentary outgrowth, the erection of parts of the body such as crests and tail-feathers, the growth of weapons on the one hand and embracing organs on the other, as natural developments of the intensely living, lusty male, as natural individual developments, whose results have gradually been incorporated in the heredity-bundle. But is not this too simple a view of the matter? It has not been proved that Nature works in this *direct* way. The suggestion above made is that such measure of congruence as there is in, say, masculine sex-characters (*e.g.* brighter colouring, exuberant decoration, smaller size) may be hypothetically interpreted as due to their having arisen as germinal variations or mutations in germ-cells predetermined to develop into males.

CHAPTER V

WHAT DETERMINES SEX?

The determination of sex—Different lines of inquiry—Possible influence of environment on developing organism—Possible importance of the relative condition of the germ-cells at fertilisation—Are there predetermined male-producing and female-producing germ-cells?—The Mendelian view of sex—Possible influence of environment in determining the relative numbers of male-producing and female-producing germ-cells—A physiological view.

THE DETERMINATION OF SEX.—From ancient times much interest has been taken in the question: What settles the sex of the offspring? Many of the answers are bound up with "theories of sex" of an unscientific sort, whose name is legion. There are several scores of books and pamphlets dealing with the problem, most of which must be dismissed at once because of obviously fatal defects in their scientific procedure. Some lay stress on whimsical conditions, which cannot be seriously considered; others on unverifiable factors, such as the parental desire for a male child. Some are physiologically absurd; and others base a big generalisation on an outrageously small number of cases.

The general problem is: What determines whether a fertilised egg-cell will develop into a male or a female organism? But let us look at a few particular forms of the problem. What are called "true twins" in the human race arise from the division of an ovum into two independently developing cells, and they

are always of the same sex. But ordinary twins, which arise from two distinct ova developing simultaneously, are often of different sexes. Why this difference in the two cases?

The eggs which the queen-bee lays without fertilising them from her store of spermatozoa (received from a drone in her nuptial flight) develop into drones, but the likewise unfertilised eggs produced during the summer months by green-flies or aphides develop into females—parthenogenetic viviparous females—until the end of the season, when males are produced. Why are the cases so different?

In one household the family consists of boys and girls; in a second of boys only; in a third of girls only. Why is this?

DIFFERENT LINES OF INQUIRY.—Since Darwin's day the problem has been attacked scientifically, along three distinct lines—

(a) Some conclusions as to the determination of the sex of the offspring have been based on statistics, for instance, as to the relative numbers of male and female offspring produced in different localities, at different times, with different ages of parents, and so on. It is said, for instance, that late marriages tend to increase the proportion of boys, that after prolonged wars when men are scarce more boys are produced, that the younger the mothers the more girls there are born.

(b) Some conclusions as to the determination of the sex of the offspring have been based on the minute study of the germ-cells in particular cases. Thus it has been shown

that some animals produce two kinds of ova, *e. g.* large and small, and that the larger develop into females. This may be illustrated by *Hydatina senta* among Rotifers; the large eggs develop into females, the small ones into males.

(c) Some conclusions as to the determination of the sex of the offspring have been based on experiment, *e. g.* subjecting the eggs, or the embryos, or the parents, to peculiar conditions of nutrition, temperature, and the like, and observing whether the numerical proportion of the sexes in the offspring is in any way different from that which obtains in ordinary conditions; or by contrasting the results of fertilising immature and over-ripe ova; or by contrasting the results of using fresh or stale sperms; or by trying particular breeding experiments in reference to what are called sex-limited characters.

POSSIBLE INFLUENCE OF ENVIRONMENT ON DEVELOPING ORGANISM.—The first theory we shall notice lays emphasis on "Nurture" in the wide sense. It supposes that in some cases the sex of the offspring remains undetermined for a considerable time, and that environmental conditions—nutritive in particular—give the bias to one side or the other. Yung, of Geneva, who was one of the first to attempt the experimental study of sex-determination, found that tadpoles, which normally develop into about fifty-seven females to forty-three males, yielded, when fed with beef, fish and frog-flesh, respectively, seventy-eight, eighty-one, and ninety-two females in the hundred. But Yung did not

pay sufficient attention to differential mortality, and this defect in method has vitiated a number of similar experiments.

Several experimenters, for instance, have noticed that when a crowd of caterpillars are under-fed, there is an unusually large proportion of males among the survivors. But as the sex of the caterpillar is really determined before it hatches out of the egg, the experiments only showed that there may be great differences in the rate of juvenile mortality in the two sexes. The females seem to be more susceptible to starvation.

It used to be supposed that between the beginning of the individual life (the fertilisation of the ovum) and the time when sex-characters become clearly apparent, there is an intervening indifferent period. But more penetrating research has shown in many cases that this so-called indifferent period, if it is a reality at all, is very short. In many cases it is possible to distinguish microscopically between the male and female gonads in the very young embryo.

It is important, however, to bear in mind cases like that of the male crab referred to in Chapter IV, where a testis destroyed by a parasite was replaced by an ovary producing eggs. There was no indefiniteness about the crab's sex-determination; what happened was the activation of the germs of femaleness, and also of feminine characters, of whose latency there is evidence in many different kinds of males. Now and again these awake a little if there is a thoroughgoing change of constitution, such as the parasitised

crab so well illustrates. Oftener, however, we find cases where in a female's body normally latent masculine characters are awakened into expression.

A number of interesting experiments have been made with organisms that are often, but not always, hermaphrodite, such as the grey freshwater polyp, *Hydra grisea*, and the prothallia (sexual generation) of some ferns. It has been shown that optimum conditions result in a predominance of females, and that groups wholly male can be produced by relative starving. What happens in these cases is the inhibition or suppression of one set of sex-organs in favour of another, and although the frequent or normal occurrence of hermaphroditism removes the instances given from the case of ordinary unisexual organisms, we submit that the facts are relevant in showing how closely sex and metabolism are wrapped up together.

POSSIBLE IMPORTANCE OF THE RELATIVE CONDITION OF THE GERM-CELLS AT FERTILISATION.—A second theory—a favourite one with breeders—supposes that the sex of the offspring is settled by the relative condition of the germ-cells at the time of fertilisation. Some say that if the ovum come from a young mother and the sperm from an older father, the offspring will tend to be male. Others say that an ovum fertilised soon after ovulation is likely to develop into a female. Many breeders maintain that the sex of the offspring tends to be that of the more vigorous parent—a favourite theory with the fathers of many boys. But a solid foundation on

which to base these and similar views has not been supplied. We have, however, two very careful sets of experiments. O. Schultze experimented with enormous numbers of mice, and found that the proportions of the sexes were not affected by differences in the ages of the parents, by differences in apparent vigour, by close inbreeding, or by frequency of successive births. Nor did he find that any kind of nutritive change made any difference. As the outcome of prolonged experiments with frogs, Hertwig and Kuschakewitsch found that either over-ripeness or under-ripeness of the eggs (due to artificially delaying or hastening fertilisation) led to a large excess of males. Kuschakewitsch, working with ova of a high degree of over-ripeness, actually got cultures of males only, and with only 4.6 per cent. of deaths.

It will be seen that these two sets of experiments point in opposite directions. For frogs, it appears that the state of the ovum at fertilisation is very important; for mice, it appears that much may be changed without affecting the proportion of the sexes. It may be that the particular change of condition that does make a difference has been hit upon in the case of frogs, and missed, as yet, in the case of mice. It may be that sex is determined in different ways and at different times at the various levels of the scale of being.

ARE THERE PREDETERMINED MALE-PRODUCING AND FEMALE-PRODUCING GERM-CELLS?—It is possible that many ova are so constitutionally predetermined that they will

develop into females only, while others will develop into males only. We are sure that this is possible, because in the vine-pest *Phylloxera* among Insects, and in *Hydatina* among Rotifers, and in other cases, there are large eggs which develop into females, and small ones which develop into males. In both these cases the ova develop without fertilisation, so that there is no question as to the possible influence of the sperm.

Reuter has shown in one of the mites (*Pediculopsis*), and Von Malsen has shown in a primitive worm called *Dinophilus*, in both of which fertilisation occurs as usual, that there are large egg-cells which develop into females, and small egg-cells which develop into males. Size is never of much account except as an index of something deeper, and it is interesting to note that the Marchals have proved that the asexually produced spores of some of the mosses, though all similar in appearance, are individually predestined, indeed, fixedly predetermined, as male-producing and female-producing units.

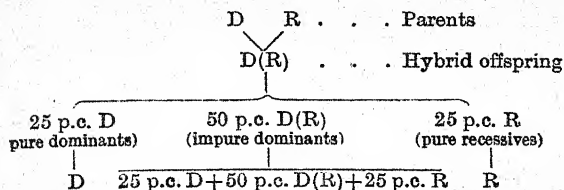
We have already mentioned that "identical twins," which are developed from one ovum, are always of the same sex. In one of the armadillos (*Praopus* or *Tatusia hybrida*) Von Jhering found on two occasions eight embryos, apparently from one ovum, and all male. In some of the parasitic Hymenoptera, such as *Encyrtus*, one ovum forms a group of embryos, all of the same sex—female if the egg be fertilised, male if it be not fertilised. These facts suggest that the sex of the offspring is already settled in the ovum, but

that fertilisation may be necessary if a female is to develop.

In about thirty different kinds of animals there are two kinds of spermatozoa differing in detail of form, but the significance of this dimorphism is not known. Of greater interest is the fact that in a considerable number of animals, especially insects and arachnids, half of the spermatozoa have in their nucleus the same number of nuclear rods or chromosomes as the ova have, while the others have one fewer. This extra chromosome, which half have and half have not, is called the X-element or accessory chromosome, and there are facts which go to show that the presence of two X-elements in the fertilised ovum implies development into a female organism, while the presence of only one means a male. It is possible that the amount of chromatin is of some importance, the ova with more chromatin developing into a female. It is possible, as E. B. Wilson suggests quite provisionally, that the X-element contains factors (ferments or hormones?) that are necessary for the development of maleness or femaleness, and that they are so adjusted that in the presence of a single X-element the male character finds expression, while in the presence of two X-elements the female character is liberated.

THE MENDELIAN VIEW OF SEX.—In the volume on **EVOLUTION** a brief reference has been made to the important discovery known as Mendel's Law which formulates the mode of inheritance of certain kinds of characters—called unit characters or Mendelian

characters. In simple clear-cut cases the gist of the matter may be thus stated. If A be a well-established, pure-bred variety with a certain differentiating character (D), *e. g.* a colour, a crest, long fur, horns; and if B be another well-established variety with a corresponding but contrasted differentiating character (R), *e. g.* another colour, no crest, short fur, hornlessness; and if A and B are crossed, the hybrid offspring (F_1) will resemble one of the parents only, say A, as regards the contrasted characters in question. The character (D) that prevails was called by Mendel a dominant; the character (R) that remains latent was called a recessive. (In many of the cases now known the dominance is imperfect, more or less of the recessive character being exhibited, but it is unnecessary to discuss this.) Now, if the hybrids be bred together, their descendants will be of two kinds, three-fourths of them with the dominant character and one-fourth of them with the recessive character. When those with the recessive character are inbred, they yield only recessives. They are pure or homozygous as regards this recessive character. When those with the dominant character are inbred, a third of them yield only dominants (to put it shortly), and two-thirds of them yield dominants and recessives in the previous proportion of about three to one. That is to say, a third of the dominants are pure or homozygous dominants; while two-thirds of them are impure or heterozygous in respect to the dominant character. Diagrammatically expressed, the facts are—



To illustrate contrasted Mendelian characters we may select a dozen and place them in parallel columns—

DOMINANT.

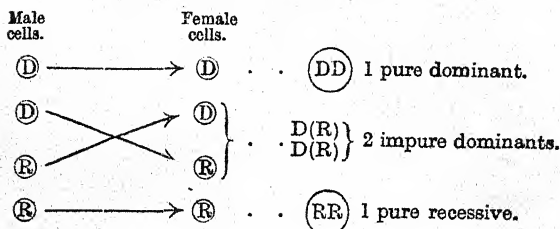
Hornlessness in cattle.
 Short hair in rabbits.
 Normal movements in mice.
 Crest in poultry.
 Broodiness in poultry.
 Unbanded shell in snail.
 Tall stems in peas.
 Round seeds in peas.
 Absence of awn in wheat.
 Red chaff.
 Two-rowed ears in barley.
 Markedly dentate leaves in nettles.

RECESSIVE.

Presence of horns.
 Long Angora hair.
 Waltzing in mice.
 Absence of crest.
 Absence of this.
 Banded shell.
 Dwarf stems.
 Wrinkled seeds in peas.
 Presence of awn.
 White chaff.
 Six-rowed ears.
 Slightly dentate leaves.

So far, very briefly, the results of experiments; but Mendel also suggested an interpretation. In the case of the hybrids (F_1) he supposed that the germ-cells were formed of two kinds in equal proportions, each kind bearing only one of the two contrasted or alternative characters. If each of the hybrids of the F_1 generation produces in both sexes 50 per cent. of its germ-cells bearing the item or factor corresponding to the dominant character, and 50 per cent. not bearing it, if fertilisation be fortuitous, 25 per cent. of the

fertilised egg-cells will bear only the dominant character, 50 per cent. will bear both the dominant and the recessive character (only the dominant being eventually expressed or well-expressed), and 25 per cent. will bear only the recessive character. This is the theory of the segregation of pure gametes and it is the central conception of Mendelism. A scheme will make it clear. (See *Evolution*, p. 135.)



When an organism produces only one kind of germ-cell, as regards a particular character, it is said to be homozygous; when it produces two kinds of germ-cells, some bearing the factor of a given character, and others not, it is said to be heterozygous. Thus in our previous scheme the forms labelled $D(R)$ are heterozygous, while those labelled D or R are homozygous.

If sex, like any other character, is due to some item or factor or determiner in the chromosomes of the germ-cells (situated, it may be, along with sex-linked characters, in the sex chromosome already referred to), there are three theoretical possible Mendelian interpretations. Both males and females

may be sex-hybrids or heterozygous—male $D(R) \times$ female $D(R)$ —a view supported by Castle; or the male alone may be heterozygous, the female being a homozygote recessive—male $D(R) \times$ female R —a view supported by Correns; or the female only may be heterozygous, the male being a homozygote recessive—a view supported by Bateson.

The last form of the Mendelian interpretation is supported by a number of striking facts, especially in regard to the common currant moth and the canary. In the case of the currant moth (*Abraxas grossulariata*), it is believed that the females are heterozygous (having maleness recessive) and give rise to equal contingents of male-producing and female-producing ova; that the male moths are homozygous as regards sex, being without "the femaleness-factor," and give rise only to male-producing spermatozoa; that when a male-producing spermatozoon fertilises a male-producing ovum, the result is of course a male; and that when a male-producing spermatozoon fertilises a female-producing ovum, the result is a female, femaleness being by hypothesis dominant over maleness. If the Mendelian interpretation of sex-inheritance be confirmed, it will probably be found that in some types the male is heterozygous and in others the female. A third possibility is that both sexes are heterozygous or sex hybrids. If the Mendelian view be confirmed it means that maleness and femaleness behave in inheritance like shortness and tallness in dwarf and giant varieties of pea; it implies that there is some definite body—perhaps of

the nature of a ferment—which is either present or absent in every germ-cell. This is not at all incompatible with a physiological interpretation, for it may be that this mysterious sex-determinant acts as an accelerator or depressor of the rate of metabolism; and it may be that the nutritive conditions within the reproductive organs during the processes of oögenesis and spermatogenesis exercise a discriminate selection allowing more of the male-producers or more of the female-producers to survive.

The Mendelian interpretation accounts well for the usual equality between males and females in a given stock, less well for the strange disproportions which occur within a single family. The latter may, however, be due to a discriminate selection during the production and maturing of the ova.

Doncaster refers to the confirmation which the Mendelian theory of sex receives from the results of castration. In vertebrates, the castration of the male may prevent the expression of masculine features, but it does not induce the expression of feminine characters. This would suggest that the male is homozygous, that is to say, purely masculine, without any feminine characters latent. The castrated female, on the other hand, often develops a striking series of masculine features, which suggests that she is heterozygous, *i. e.* with masculine characters latent. We would point out, however, that in many cases there is a lack of positiveness in the feminine characters as compared with the masculine ones. So that there might be considerable femininity

in the castrated male, without there being much to show for it. It would be interesting to experiment with some exceptional case, such as the Red-necked Phalarope, where the female bird looks the more masculine of the two.

POSSIBLE INFLUENCE OF THE ENVIRONMENT IN DETERMINING THE RELATIVE NUMBERS OF MALE-PRODUCING AND FEMALE-PRODUCING GERM-CELLS.—Recent observations have gone much against the view that the sex of the young offspring can be affected by peculiar nurture. It is possible, however, that nurtural conditions, such as the nutrition of the parents, may be influential at any earlier date, *e. g.* in determining the relative numbers of male-producing or female-producing ova, or in determining the percentage of survival of one kind or the other, for there is often a struggle for existence among germ-cells. We recall, for instance, the green flies which produce females all the summer through, but suddenly produce males on the advent of autumn. It may be that the seasonal change, acting on the nutritive condition of the maternal body, brings about the production of ova that develop into males.

The careful experiments that Cuénot and Schultze made on mice with a view of testing whether altered nutrition affected the ordinary proportion of males and females, gave no support to that view. Schultze extended his experiments over three generations; but the high feeding of grandparents, as well as parents, did not seem to have any influence on the proportion of the sexes among the offspring.

On the other side, there is the work of Heape, who shows for some mammals and birds that peculiarities in nutritive and other environmental conditions may exert a selective influence, affecting the numerical proportions of male-producing and female-producing germ-cells. Russo has made interesting experiments in treating rabbits with lecithin (a very nutritive substance forming a great part of yolk of egg), as the result of which he thinks he is able to increase the number of female offspring, namely, by increasing the production of a certain type of ova, rich in nutritive reserves. His experiments have been adversely criticised, and they were not numerous enough to win conviction. Until repetition of the experiments on a big scale has shown that Russo was in error, his thesis should be kept in mind, that the sex of the offspring depends on the special metabolism of the germ-cells, and that the number of ova which exhibit the male or the female type of metabolism is alterable by the environmental conditions. This is, in fact, part of the thesis of our *Evolution of Sex*. Remembering the case of mice, however—and there are others equally negative—we are prepared to find that it is only in certain organisms that the germ-cells are not predetermined very early in their history.

Many investigations have yielded results quite against the view that changes in environment can change the numerical proportion of the male and female offspring—which is in most cases near equality. On the other hand, there are some investigations which

support the view that changes in nutrition and other environmental conditions may affect the mother so as to alter the ordinary proportions of the sexes—probably enough by affecting the relative numbers of male-producing and female-producing germ-cells. Thus Issakowitsch, working with the parthenogenetic females of one of the water-fleas, *Simocephalus*, and Von Malsen, working with the primitive worm-type, *Dinophilus*, in which the ova are fertilised, found that differences of temperature affected the proportions of the sexes, apparently by affecting the nutrition of the mothers. Both sets of experiments are the more satisfactory that they seem to be free from any fallacy due to differential death-rate in the young of the two sexes.

A PHYSIOLOGICAL VIEW.—To the view of sex, expounded in *The Evolution of Sex* in 1889, a reference must again be made, for we find ourselves unable to get away from the conviction that there is no sex-determinant or factor at all, in the morphological or in the Mendelian sense, but that what settles the sex is an initial difference in the rate or rhythm of metabolism. This may also be expressed as a difference in the relation of nucleoplasm and cytoplasm, as well as in the ratio of anabolism to katabolism.

According to this view, the deep constitutional difference between the male and the female organism, which makes of the one a sperm-producer and of the other an egg-producer, is due to an initial difference in the balance of chemical changes. The female seems to be relatively the more constructive,

the male relatively the more disruptive. The sexes express a fundamental difference in the rhythm of metabolism.

A young germ-cell has, metaphorically, an alternative between two different, but equally viable, lines of life—the male and the female. It is shunted on to the one or the other by the surrounding conditions. Influences which favour a preponderance of anabolic processes, which affect the nucleus-cytoplasmic relation in a manner favouring cytoplasmic assimilation, tend to the increase of female-producing eggs. Influences that operate in the opposite direction favour the increase of male-producing eggs.

What we are suggesting is a physiological way of looking at the problem, and the idea that the sex-contrast expresses a physiological alternative. This is confirmed in various ways. For instance, there is sometimes very striking evidence that sex is "a quality that pervades all the cells of the organism." E. B. Wilson notes the extraordinary fact—surely of profound importance—that: "In the Mosses the Marchals demonstrate that all the products of a single spore are likewise immutably determined, since new plants formed by regeneration from fragments of the protonema, or from any part of the gametophyte, are always of the same sex."

Of the association of maleness (or sperm-producing) and femaleness (or ovum-producing) with different conditions of metabolism many illustrations might be given, but we must be content here with two or three. Is it not significant, for instance, that in some cater-

pillars the blood has a different colour in the two sexes, being green in the females and bright yellow or colourless in the males? Dr. Francis Hare has made out a very good case for the theory that menstruation represents a periodic discharge of carbonaceous anabolic surplus in the blood—which is earmarked, so to speak, for the organically anticipated offspring. What but a physiological theory is suggested by the state of affairs described by G. du Plessis in *Grubea protandrica*, one of the Syllid worms, which is male in autumn and winter, female in spring, and neuter in summer?

It is interesting to consider those cases where the sex changes in the course of life! A case recently described by Prof. F. Braem is very suggestive. He experimented with a simple Annelid worm, *Ophryotrocha puerilis*. Taking a female which had ripe eggs and showed no trace of hermaphroditism, he divided it into two. The head portion, with thirteen segments, was isolated. In three weeks it had regenerated seven segments with parapodia. It was then killed and found to be male. The ova had mostly disappeared from the reproductive organs, leaving only a residue, and a functional testicular portion had developed, which was producing spermatozoa. Braem suggests that in consequence of the amputation the very young, indifferent germ-cells had developed into male cells, which require less subsistence than ova. What is certain is that the reproductive organs had changed from producing eggs to producing sperms, and such

cases appear to us to favour the view that the sex-difference is fundamentally physiological.

In conclusion, our view is that the difference between an ovum-producer and a sperm-producer is fundamentally a difference in the balance of chemical changes, *i. e.* in the ratio of anabolic and katabolic processes, which may, of course, have its structural expression in the relation of nucleoplasm and cytoplasm. Nor do we leave this difference in metabolism-rhythm as a mere vague phrase, for we see its analogue in the contrast between the ovum and the spermatozoon, macrogamete and microgamete, between the encysted and the flagellate cell, between the plant and the animal, and in many a familiar contrast all through the series of *Organisata*. We adhere, in short, to the thesis of *The Evolution of Sex* that the sex-difference is but one expression of a fundamental alternative in variation, to be seen throughout the world of life. But we may add that the numerous and puzzling minor variations, which, as we have above seen, exist between species and species, may be explained, not so much in terms of the structural and the hereditary differentiations which embryologists and Mendelians are wont to look for or to assume, but rather in terms of time-variations; that is in acceleration or retardation of the phases of life in adult or in embryo, in sex-elements or in their initial germ-cells, and in the interrelations of these.

CHAPTER VI

THE CYCLE OF SEX

The curve of life—Childhood—Adolescence in general—Puberty in man—Courtship among animals—Falling in love—Married life and parental affection—The difficult age and senescence.

THE CURVE OF LIFE.—The course of an individual life may be conveniently represented by an ascending and descending curve. There is the ascent of development and growth; there is the period of maturity, full strength and reproduction; and there is the descent of waning powers and senescence. In adaptation to particular conditions of life and as expressions of particular constitutions, there is among animal types a remarkable diversity in the shape of the curve. There are great differences in the relative proportions of the successive chapters in life. There may be slow or rapid embryonic development—witness the contrast between the salmon with its years of growth and the blow-fly complete in a few days. There may be a long larval period, as in the frog, or none, as in the snake; there may be a prolonged adolescence, as in an eel, or a precocious maturity as in a rat. Here we see a lengthening out, and there a not less remarkable telescoping. What a contrast, for instance, between may-flies with a long aquatic larval life of two or three years and a short aerial adult life of two or three days, and the majority of, say, amphibians with their

relatively short youth and their prolonged adult life. Not only then does the general shape of the curve differ widely in the various types, but looked closely into, it shows all manner of minor irregularities, ups and downs like a pulse or a barometer tracing, and the pattern of these again differs widely from species to species. Molluscs strikingly record these tides of life upon their shells, sometimes so clearly that upon a few full-grown examples of the top-shell (*Trochus*) we may not only read the normal record of the species, but within this again the minor fluctuations of each individual's life history—his personal equation as it were; and not only his accidents, but his ailments and recoveries, throughout adolescence, in maturity, and above all in senescence.

CHILDHOOD.—The remarkable work of Freud, which is now being reckoned with by alienists and physicians, emphasises the view that in very young children there are often experiences more or less connected with sex, which may have considerable influence on the subsequent life, sowing the seeds of hysteria and obsessions. Unless Freud's psycho-analysis be unsound there is a more or less subconscious sexual life in young children, which may be exaggerated by careless caressing, exuberant fondling and worse, into a very detrimental precocity or into unsuccessful attempts at repression which may find pathological means of gratification. In normal cases, happily, the infantile deviations pass into oblivion; and there is a happy period of latent sex until puberty approaches.

It must not be overlooked that while a pathological side may exist in very early years, there is a still more important normal experience, for even the infant is garnering, though it be half-consciously, its mother's love. In the subsequent play-period there is doubtless a partly imitative and partly instinctive, but normally quite subconscious, expression of the deep constitutional sex-differences.

ADOLESCENCE IN GENERAL.—Leaving the babe to his mother and the expert in eugenics, and the child to his play and all that is summed up in the word "School" (see Prof. Findlay's excellent *School* in this Library), we have here to do with the adolescent. We may regard adolescence as a main node on the ascending curve of development, when childish ways and childish things are put away, when juvenile characters are for the most part slipped off as a crab slips off its shard, when adult characters are gradually put on, when the life begins to take definitive shape, when the limit of growth comes within sight, and when sex-impulses, at first mere passing whispers, compel a hearing to their mingled voices. As regards the latter it is practically the period between fifteen and twenty or more in boys, between fourteen and eighteen or nineteen in girls.

We may profitably compare human adolescence with the analogous period in animal development; for while everything became in a sense new with Man, there is an essential unity of life which makes the whole world kin. The growth of an organism is usually a

good illustration of the law of diminishing return; it is an ascent whose gradient becomes steeper and steeper towards the top. But although the early rapidity of growth is never afterwards approached, there is often in animals, as in man, a remarkable re-acceleration towards adolescence. This means a serious drain on the available energies of the organism, and the candle cannot be burnt at both ends. There is increasing stability and yet increasing instability, there is great vigour and yet great "slackness," and the rapidly growing adolescent is naturally a good deal preoccupied—organically, not consciously, preoccupied—with his or her internal affairs. All this means that he or she should have plenty of rest and plenty of play.

The study of adolescent animals leads us to include in our conception of adolescence the idea of internal change, rearrangement, and readjustment. The adolescent creature becomes more complex, from its teeth to its nerve-paths; there is new differentiation. But it also becomes—if adolescence be successful—more controlled, more unified, more strongly vertebrated, more toughly and subtly knit together; there is new integration. This twofold progress is not achieved without cost; there are "growing pains." In the transition from tadpole to frog, from caterpillar to butterfly, there are remarkable processes of breaking down and rebuilding, and crises of inflammation that are sometimes fatal. Now we must in some measure carry with us to the study of human adolescence this idea of redifferentiation and reintegration (*i.e.* of

new complexities and new controls)—gains which have to be paid for. Thus it is that adolescence is full of portent as well as promise.

A third biological fact must enter into our conception of adolescence. It embraces the momentous, critical time when decision is given in regard to the individual variations that crop up during the juvenile period. It is in early youth that variations or new departures take shape; the play period (poorly though we provide for this) gives them some elbow-room; but it is in adolescence that they have to run the gauntlet, and this at once of natural selection and of social criticism. From one side threaten the conditions of the organic struggle for existence, on the other the rules of the serious game of life, and with these come all sorts of restrictions, from the law of the jungle to the conventions of social behaviour; each and all closing in upon the individualities, the idiosyncrasies, the peculiarities, in a word, the *variations* of the young life. The same thing applies, in a measure at least, to *modifications*, that is to say, those bodily and mental peculiarities which are acquired as the result of peculiarities of nurture. Great modifiability is characteristic of early youth, but it is often during the later adolescent period that it is decided whether a piece of juvenile veneer is to persist or not. When youthful modifications, for good or ill, survive the adolescent period, the chances are that they will persist throughout life.

PUBERTY IN MAN.—Puberty is not so much an event as a result, that of a gradual process

of bodily ripening, which is quickened by the maturation of sex. In illustration of the ordinary changes which mark this stage in the life of the body, we notice the beginning of the coalescence of the caps of the long bones with their shafts, and, as a negative character, the disappearance of the thymus gland, which is a distinctively juvenile organ. As sexual changes, the male shows an increased growth of hair, an enlargement of the larynx, and an increase in the size of the genital organs; the female shows a change in the shape and size of the uterus, an enlargement of the mammary glands, and the onset of menstruation. While the reproductive organs, through their internal secretions, have been influential all through development, they come to have a special influence when mature. And besides the influence of the internal secretions, there is that due to the fact that the essential or germinal parts of the gonads have passed into more active functioning.

At the time of sexual maturity, according to Steinach, the brain is greatly influenced by the internal secretions, it is "eroticised," and this has far-reaching influences on the metabolism. Through the vaso-motor system the changes in the brain affect the blood-supply to various parts of the body. The organism becomes impressionable to the other sex in a new way. Certain sympathetic ganglia become increasingly susceptible to peripheral stimulation. And the brain-ganglia become disposed to lower the tonus of certain inhibitory centres in the spinal cord. Of course, there are also psychical factors which,

in Man's case, may be as supreme, as the hormones and nerve-cells are fundamental.

It is at puberty that the conflict first becomes serious between the life-instinct which seeks self-preservation and advancement and the love-instinct which is not less primordial. The former is the more egoistic, the latter the more altruistic; the former is linked primarily to nutrition, the latter to reproduction. In everyday life they clash; there is a struggle between the compulsion of the sexual instinct and the opposing force of sexual denial which may owe its strength to ethical, religious, or practical inhibitions. The outcome of the struggle may be damaged health, a bondage to evil habits, a serious neurasthenia, the establishment of "anxiety neuroses"—most of these being fictitious substitutes for the activities which should naturally accompany or follow normal sexual arousal. But the outcome may also be a strengthened control, an enriched life, and a love that will not die. It must be remembered that other besides sexual factors are in operation during the adolescent period, for the organism is being tried and tested in many ways. Thus it is certain that the disorder or disharmony is by no means wholly due to the unsatisfied claims of the reproductive system, but is associated with a lack of objective, of sound human interests, and of real responsibilities.

COURTSHIP AMONG ANIMALS.—In discussing "the ladder of love" we have referred to the great variety in the behaviour of the two sexes in their relations to one another

at the breeding season. The broad facts are, that there is often an over-mastering excitement changing the animal's character and appearance, that there is often a seeking out of the females by the males and rarely the other way, that the excited males in many cases fight fiercely with one another, and that they often make displays—of agility, mettlesomeness, of beauty, of fragrance, of musical talent, and so forth—before the senses of their desired mates. The difficulty is as to the psychological interpretations to be put upon the facts. One is apt to be uncritical in reading too much of man into beast; yet again, reacting from a too generous anthropomorphism, one is apt to take a wooden view of animal life, by depreciating the psychical side.

In giving a few illustrations of courtship among animals (the subject of a recent fascinating volume by Mr. W. P. Pycraft), we may begin with the combats of rival males, since these often take place in presence of the females and appear to have in part the effect of arousing or enhancing their sexual excitement, as well as expressing that of the males themselves. Stag may fight with stag till they drip with blood, it may even be till the antlers interlock, and death is stronger than them both. We have seen an old buck antelope punishing a presumptuous upstart with a fury that seemed almost maniacal. The rival sea-lions slash at one another's necks with their sharp canines and make long wounds whose scars remain for many a day.

Among birds, the capercailzie cocks fight savagely in the early spring till the snow is often spotted with their blood. From the shelter of a sheep-fold just after sunrise we have watched the jousting of four or five blackcock on a flat sward among the hills. Almost transfigured they were with passion, so that we could scarce believe they were the same birds; and how absorbed as they bluffed one another, spreading their wings, raising their tail, bowing till their chin touched the ground, or vaulting into the air. From the branches of two small alder trees numerous females looked down on the tournament of the cocks, and were seemingly very much interested spectators.

In a lighter mood the ruffs—so extraordinarily individualised that no two are alike—fight the whole day long in the fens-lands (no longer, alas! in Britain). About anything or nothing these glorified sandpipers fight almost as dramatically as gamecocks, seizing one another by the beak, leaping into the air and striking with the wings; and it is likely that those who excel in the after all bloodless jousts have their reward in impressing the females and driving off rivals. For the ruff is a thoroughgoing polygamist. It is interesting to notice, also, that as with the blackcock, the sparring between the males is supplemented by a self-abandoning display. "Nothing," says Wolley, "can be more expressive of humility and ardent love than some of the actions of the ruff. He throws himself prostrate on the ground, with every feather in his body standing up and

quivering; but he seems as if he were afraid of coming too near his mistress."

Some male spiders fight with apparent seriousness at the breeding season, but the meaning of the fighting is doubtful. The Peckhams, who watched "hundreds of seemingly terrible battles" between the males in twelve different species, came to the conclusion that "they are all sham affairs gotten up for the purpose of displaying before the females, who commonly stand by, interested spectators." And though a phrase like "sham fight" be somewhat too anthropomorphic, there is certainly a puzzle, for the males in their duels seem to take very good care not to hurt one another. "It seemed cruel sport at first to put eight or ten male spiders into a box to see them fight, but it was soon apparent that they were very prudent little fellows." . . . "In fact, after two weeks of hard fighting we were unable to discover one wounded warrior."

It is difficult to deal briefly with the problem of the significance of the combats. In a few cases, as in sea-lions, they may be regarded as literal and serious combats for the possession of females—of a larger harem in fact. In many cases, such as some antelopes, they have the effect of driving off candidates who are too weak or too young to hold their own. Some of these are left unmated till the next season, and some are even killed. Thus there will be worked out a discriminate elimination of the relatively less fit males, and here sex may be said to operate as a factor in evolution.

It is probably unwarrantable to speak of the males getting up their tournaments in order to impress the females. They fight to win the females, they fight because they are jealous, they fight because they are high-strung, they fight because of the irritability induced by unsatisfied sexual appetite, and so on; but it is very unlikely that they fight "in order" to impress. What probably happens is that certain males in their whole behaviour excite the females more effectively than do others, and are in consequence more successful in reproduction. The type successful in courtship will naturally tend to define the direction of further evolution.

Pass now from combat to song, in the old minstrel fashion. Every one recognises that the musical displays of singing birds play an important role in their courtship; and it is well nigh inevitable to draw a similar conclusion in regard to the instrumental music of crickets, grasshoppers, cicadas, and the like—especially in cases where the sound-producing is confined to the males. It is difficult to believe that the noise falls on deaf ears, and yet the evidence is far from conclusive. Instead of collecting representative forms of animal courtship, let us linger over this single question to illustrate the difficulty of the problem. Many insects have sense-organs which may be interpreted as auditory, but there is little direct proof of this. In fact, the numerous experiments that have been made with the hope of definitely settling whether insects hear have not yielded convincing results. They have shown that

there are many sounds to which insects credited with hearing pay no attention whatsoever. Perhaps these sounds were not of the sort to which insects' ears are attuned, and Dr. Karl Peters suggests that the experiments which have yielded negative results have been too much restricted to sounds that have no biological significance to the creatures experimented with. He has, himself, made careful observations on a case which strongly suggests that there may be hearing in the strict sense, and that the production of sound may be utilised in insect-courtship.

Peters's observations relate to an Alpine moth which is abundant at Arolla, at a height of about 2500 metres. The males fly about actively; the females are sluggish, and sit mostly on the tussocks of grass, where they are very inconspicuous. The males are able to produce a cracking noise, which is peculiar to them, and the females respond to this, even when it is impossible for them to see the males, by vibrating their body and wings. The reaction on the female's part begins when the male flies past overhead or settles down close by; *it stops when the sound stops*. It seems difficult to avoid the conclusion that the female hears the male's love-signal. It seems likely that sight plays a rôle on his part, and that the tremulous, vibrating movements of the female attract his attention.

We cannot say more in regard to this fascinating subject of animal courtship. In a great variety of ways, male animals seem to

express their emotions in the presence or proximity of their desired mates. Many male spiders have a characteristic love dance, in which they circle round and round the short-sighted females, as if they were showing off their agility and beauty. Many birds, such as the Argus pheasant and the peacock, make elaborate displays, bending and bowing, strutting and saluting, in a manner that beggars description. Finest and most familiar is the musical appeal of many birds. We

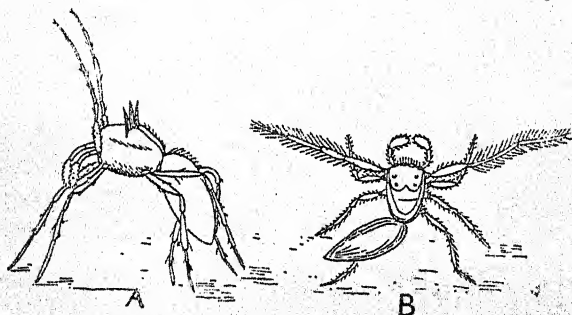


FIG. 19.—Two male spiders. A, *Astia vittata* posing before the female. B, *Icius mitratus* dancing before the female. (After the Peckhams.)

must not read too much into them, for the suitors are as it were sex-intoxicated, expressing their ardour instinctively and with abandon, rather than with deliberation or strategy. But we must not think of them too cheaply, or surrender them too readily to the physiologist to whom love is a mere label for the alterations of metabolism that follow from the brain being eroticised by hormones.

FALLING IN LOVE.—Coming now to human

affairs, there is a sense in which "falling in love" may be termed instinctive, if we take instinct to mean a reaching-out of the whole organism—impulsively rather than deliberately, synthetically rather than analytically, intuitively rather than rationally. We are not referring to a passing fancy for a pretty face, nor to a sudden impulse of the flesh, but to something much more wonderful—which is probably the highest expression of "instinct" in the Bergsonian sense. It is the feeling—say rather the instant and vivid assurance—that this is the person who is well-pleasing in my sight, whom I wish to honour, who calls forth what I believe to be the best in me, with whom I should like to live for and along with whom I should like to work,—and whom, therefore, at all risks I must win!

In normal human love there is first and fundamentally the instinctive organic attraction, which in certain temperaments may be almost subconscious. Secondly, there is the æsthetic attraction, aroused by excellencies other than those which may be roughly called "physical." We refer to qualities of voice, eyes, gesture, manner, and so on, and with these, nowadays scarce separably, of costume also. Thirdly, there is the sentimental attraction, which is purely psychical. This person, as a person, is attractive to us, winning our affection. Love is an affair of body, soul and spirit, but compounded in varying degrees in each individual, and these again changing throughout the hours, seasons, and years.

Schopenhauer recognised the value of falling in love, regarding it as an expression of an instinct, which by the attraction of the mutually pleasing, works for the eugenic welfare of the race. Féré, on the other hand, looking at the facts with a sceptical scientific eye, declares that the most impulsive and instinctive unions are most frequently the worst as regards progeny. The probability is that Féré's conclusion is too much based on the study of pathological cases, for degenerates and perverts attract one another strongly.

Alienists and others who have given special attention to the subject, whose judgment is of more value than any number of uncritical opinions, declare that the least successful marriages are those which arose from *a too specialised attraction*—too purely physical, too purely æsthetic, too purely intellectual. Marriage based solely on the attraction for high moral and intellectual qualities may be as unsuccessful (particularly as regards progeny) as marriage on a sensory basis. The lasting basis is manifold, not simple. As Féré says, "the harmonious union of mediocre people often works out better than the discordant union of those endowed with superior qualities."

All this is of course but outline analysis, but it is fundamental. The normal love of civilised man and woman is like a tree with deep roots, going far down into animal nature—roots that may be pruned, but never wholly cut—but with lofty branches that rise into the sunlight and bear the fruits of the

spirit. We do not speak indeed of love that does not rise off the ground, but of the normal love of free men and women, who are neither ashamed to be fond in due season, nor to look forward, around, or back upon their children.

The danger is in thinking of these things too simply, for human love has in the course of its evolution become a very complex relationship. The sexual attraction, at first comparatively simple, becomes more subtle, yet also more vividly impassioned; and so it intensifies into "love at first sight," at its best at once instinctive and poetic. To this there has also been added the deliberate desire for children (specific children, so to speak—sometimes even "dream-children") to continue the dual yet united line. This, again, may be at all levels, from mere wholesome breeding up to the Messianic hope of Israel of old, or again towards the renewing of old idealisms for to-morrow. So, again, from the simplest pairing to the recognition of love as a supreme mingling of self-expression and self-surrender, a mode of mutual evocation, and thus of developing fellowship and joy, long surviving the period of racial significance. Here, then, is the place for clear protest against that false (because life-embittered) asceticism which Tolstoi so fiercely revived: purer and nobler, as well as truer far to the normal idealism and companionship of wedded life in its continuance and evolution, is such poetry as that of Coventry Patmore, is such sex-ethics as that of James Hinton.

MARRIED LIFE AND PARENTAL AFFECTION.
In the Animal Kingdom we find an early

emergence of maternal care, as if the mother was loath to part with these eggs or offspring which she has created, for it has long been recognised that the care of the young is like a prolonging of gestation. Where the offspring are very numerous, as in fishes with their tens of thousands, there is neither need for nor the possibility of parental care; as fertility diminishes the possibility of parental care increases, the mother's energies are less

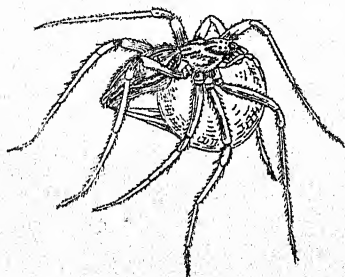


FIG. 20.—Female Spider—*Dolomedes mirabilis*—carrying underneath her body, attached by silk threads, the silken cocoon containing the eggs and eventually the young spiders. (After Blackwall.)

terribly exhausted, and the need for care also increases. There is a much smaller margin for contingencies. And the better the nurture, conversely, the more the number of the offspring tends to be reduced. Thus the bird that spends time in making a very secure and finely finished nest—an expression of its own high individuation—may very successfully hold its own as a species with a small clutch of eggs produced once a year. Similarly in mammals, the long gestation and

the maternal care after birth make a reduction of the number of the family a successful economy.

Similarly in mankind the age of marriage is pushed later and later as civilisation and culture increase, partly as a matter of necessity (analogous to infanticide and artificial abortion among peoples living near the margin of subsistence), and partly because of selfishness. Partly, too, as the result of an idea, often mistaken, of giving the family a good start, but also as a natural result of higher evolution; that of the continued uplift of individuality, through the lengthening of childhood and of adolescence. Moreover, with this goes a lengthening of the normal duration of maturity as well.

All investigators of the evolution of moral sentiments are agreed in emphasising the educative influence that children have on their parents. Just as we find a frequent correlation between sociality and animal intelligence—witness rooks, cranes and parrots, beavers, monkeys—so the life of the family must be recognised as a stimulus to wits and to good feeling alike. Féré points out very clearly that those who live in the relative security of civilisation must not misjudge the practice of infanticide among savage tribes, who are not thereby to be entirely denied the virtue of parental affection. When food is scarce and quick marches frequent, there can be few infants. And just as the method of infanticide was replaced by that of abortion, so the latter has often disappeared before a less dangerous control of conception.

To some extent there is in each individual an acquisition of culture—of sympathies in particular—through the influence of family life; but there has also been a selective process at work favouring the survival of the more domesticated types. Thus, to take a diagrammatic instance, where there is less maternal sympathy there will, on the average, be less personal nursing of infants. But that implies, again on the average, a greater mortality among these infants—which tends towards the elimination of this sub-mammalian type. Some other conditions, unhappily, work towards its persistence.

Maternal love is the highest product of evolution in its disinterestedness and unlimitedness, and though paternal love usually lags far behind, the two together are often wonderful. It is beyond our scope to treat of parental love, but its interaction with conjugal love is important. On the one hand, to put it concretely, the devoted husband is most likely to be a kind father; and, on the other hand, the love which realises itself in the family often returns enhanced to the pair. The love of offspring and the love of mates are alike ancient, but on the whole, priority may be ceded to the former. Maternal sympathy has been the very fountain of sympathy throughout the course of evolution. To the common human stock of altruistic sympathies, the females have contributed primarily as mothers, and the males above all as lovers.

Much has been written on the history of marriage and there is general agreement as

to its biological and social justification. In early days, the man's feeling of possession of the wife he had captured or bought, must have tended to secure in a somewhat coercive way her faithfulness; but the growth of conjugal and family sympathy laid on him also similar obligations. In a variety of ways, partly by deliberate ethical purpose, partly by the working of natural selection, there has been a vindication of permanent monogamic marriage. It makes for the realisation of mutual affection which is an end in itself, but, above all, it makes for the welfare of the family.

As Mr. Oliphant puts it in his admirable essay on *The Relations of the Sexes*: "It matters little that the institution of marriage was originally due, not to any prevision of its social value, but to the need for protecting the rights of prosperity, the wife in primitive times being a chattel who must be reserved for her lord. Whatever causes may have underlain the custom of making the woman the centre of a home, the happy effects on the nurture of children must soon have become evident, and the consciousness of this advantage must have been present in every further step taken to preserve the sanctity of the family. Natural selection has secured the vogue of the monogamic union wherever the conditions of life have favoured an ample social development. Experience has proved that only where the self-contained family has become the unit is the progress of a community fully assured. Whatever form of marriage favours most the

successful upbringing of children is on that ground alone to be judged the best. There can be no doubt that in the most advanced societies of the industrial type, children have the best chance where they get the undivided attention of both parents. We find here the root of the whole matter. Whatever superstructure of convention and law and sentiment may have been built up on the relations of the sexes, the corner-stone must always be the well-being of the next generation. Directly or indirectly, consciously or unconsciously, this paramount consideration will force its influence backward on the institutions of every community. Where it is ignored or inadequately realised the penalty will be decay and possibly extinction, while those societies which are most impressed by its significance will be the torch-bearers of progress."

The subject of happiness in married life is obviously too large and complex for treatment here, but three notes may be permitted—

(a) Much has been made of the diversity of the sexes and the inevitableness of antagonism. Thus Heape writes—

"It is not only the Feminine mind which is different from the Male mind; it is the whole Female organisation, her inclinations, feelings, and intuitions which are different. It is the woman's biological necessities, and all the various forces which conduce to their satisfaction, which, though complementary to those of the man for a period in their joint lives, are quite different from, and eventually

become diametrically opposed to, his needs and to the natural forces which drive him." Like Heape we start from a recognition of the deep and pervasive constitutional difference between the sexes, but we regard this as furnishing a great part of the attractiveness of the sexes for one another, both in passion and in love. A normal married life with some reasonable co-operation (and appreciation of the co-operation, it must be added) does not as a matter of fact lead to diametrical opposition of the partners, but very generally to a loving comradeship, which may, of course, be relatively humdrum or high-pitched as those involved care to make it, but which is none the less one of the fine things in life.

(b) Our second note is one already expressed, that of the underlying unity of love in its sensual and spiritual expressions alike. To biologists this is a commonplace; it is borne out very strikingly in the psycho-analytic work of Freud. And part of the advice which this expert gives us is not to forget the animal within us and the legitimate claims of sexual gratification. Sublimate this, indeed, and link it on to the best, but deny it at your peril. Marriage without fondness is often severely punished.

(c) On the other hand there is the opposite risk of conjugal intemperance. It seems likely that as men move away from the traditional patriarchal position, on the one hand, and from the acquiescence with the sex-parasitism scandal on the other hand, women will lead the way to a higher standard of

sexual temperance in married life. The phrase "monogamic prostitution" is ugly enough, but it expresses an ugly fact. Bernard Shaw touches man's animal nature on the raw when he says that "marriage is popular because it combines the maximum of temptation with the maximum of opportunity." It is likely, we venture to think, that woman's increasing sense of self-respect (inhibited by the survival of patriarchal ideas) and man's increasing respect for her, will help both towards a higher degree of temperance in married life. There is risk of smothering love in physical fondness; for the uxorious husband, the too effusive wife, seems to evoke the very opposite quality in their respective life-partners. The attenuation of the physical and the accentuation of the psychical must be regarded as characteristic of the finest marriages; and there is happily never a dearth of high examples—on the part of wives, especially—of love which never grows old.

THE DIFFICULT AGE AND SENESCENCE.

In many animals sexual activity is definitely periodic. It is in evidence at the breeding season and then ceases for the year, the gonads often passing into a state of rest. In many birds they become very inconspicuous outside the breeding season.

In the punctuation of the sexual life, there eventually comes a full stop, especially in the females, which is far from coinciding with the general life of the organism. The production of germ-cells comes to an end, and though desire may not fail, there is an end to fertility. It is possible that the

punctuation has been regulated in the course of natural selection, for it is best for the race that it should be continued by young mothers—though not immature ones. One must not make too much of the case of Isaac.

The cessation of ovum-production in women is known as the climacteric, or menopause, and its symptoms bear some resemblance to those which occur after castration. Ovulation, or the liberation of ova, ceases; the production of new ova normally comes to an end; the connective tissue of the ovary hardens, the blood-vessels degenerate, the whole organ shrinks. Associated with these essential internal changes there are others more superficial. Thus the skin loses its tenseness and tends to become wrinkled; and the deposition of fat increases, often excessively. Hairs may grow out on the upper lip and on the chin, and there is often an increase in the size of the thyroid gland.

In man there is sometimes, initially between fifty and fifty-four, but often later, a "climacterium virile," analogous to the change in woman. It appears to be associated with retrogressive changes in the gonads and often with a waning of sexual appetite. It is sometimes marked by unrest, anxiety, hypersensitiveness, irritability, sluggishness, sleeplessness, rushes of blood to the head, sudden rises of temperature, changes of blood-pressure . . . but, in fact, so many symptoms have been recorded by medical experts that the impression left is not very convincing. Perhaps, it is enough to say that with a waning of sexual activity there is associated

a considerable disturbance of the internal secretions of the body.

It is clear that outliving the capacity of independent sustenance is not feasible for ordinary animals in a state of nature, and it is not tolerated. It is also clear that each kind of organism will reproduce best when it is at its prime, and that reproduction by organisms in their declining years would be prejudicial to the welfare of the species. Therefore we do not find wild animals long outliving either their full vigour or their effective reproductivity. In Man, however, there has been an age-long successful attempt to throw off the yoke of natural selection, and the duration of life has probably been lengthened out far beyond the primitive span. For although it is a remarkable fact that the average length of human life all over the world is much the same in different countries and conditions, we need not suppose that this has always been the average. It is more likely that the waning of reproductivity about the fiftieth year indicates the end of an older span.

There seems to be no hard and fast rule as to the decline of sex in males, but, as has been indicated, it often wanes about the fiftieth year. Veterans of seventy and eighty have been known to retain all the vigour of youth, but these are very exceptional cases. Similarly, as regards women, although the production and liberation of ova may be exceptionally continued and the menopause postponed for many years, the usual punctuation is between the forty-fifth and fiftieth

year. The important point seems to be that in mankind life is continued far beyond the period of effective reproductivity, and that there is an element of danger in this. The waning of sexual desire after about fifty must surely be regarded as normal, and the fanning of its embers by artificial stimulation as unnatural and possibly pathogenic.

CHAPTER VII

CORRUPTIO OPTIMI PESSIMA

The pathological side—Pathological expressions of sex—Reasons for pathological instability—The work of Freud—General considerations.

THE PATHOLOGICAL SIDE.—Sex is the biological condition of the love of lovers—one of the finest things in the world; on the other hand it yields the pathological condition of sexual vice—"corruptio optimi pessima" (that corruption of the best which is worst of all). What can be usefully said, in a book like this, regarding the seamy side of sex? It is not useful to give samples from the infernal circle of sex-diseases, to speak of the horrors of the lock-hospital, or to tell of visits to asylums. Yet it is not honest to ignore the terrible pathology of sex, which is never perhaps very far from any one of us. Nor is it even safe to leave a fool's paradise undisturbed.

The facts do not seem to justify the fear which some have expressed that a scientific discussion of evils may suggest to the innocent

the path of vice. It appears that sexual perversions usually develop (under appropriate stimulus) in those who are unhappily born with a taint, such as lack of control; or who acquire or are led into bad habits in the earliest childhood; or who have their will-power and their sense of self-respect weakened by other vice; but there is no evidence that the appropriate stimulus is supplied by scientific treatises. It is certainly not as a path of roses that these depict the way of sexual sinners and perverts.

PATHOLOGICAL EXPRESSIONS OF SEX.
There are various bases of classification available in arranging the diverse forms of pathological sex-expression. The first of these is naturally biological—

(a) Those which have a germinal, constitutional, or hereditary origin: *e. g.* extreme sexual excitability of the congenital type, abnormal weakness of sexual desire, general lack of control.

(b) Those which are modificational or acquired, being the direct results of degenerative functions and surroundings: such as exaggerated sexuality acquired through diet, drink, etc.

Most inborn morbidities are of the nature of tendencies or predispositions, and there is hopefulness in remembering that these will not develop into actualities unless they receive an appropriate "nurture." The hopefulness of therapeutic treatment is increased by the fact that after early childhood, when bad habits are readily, though subconsciously, acquired, there is a long period of latency

to work with before the sex-impulses become naturally assertive in adolescence.

As to the acquired anomalies in the sexual life, it is the view of Freud and others that many of these must be traced back to perversions in early infancy, when through some hereditary deficiency, or through some ignorance, carelessness, or vice of nurture, habits are established which take a very prejudicial grip of the constitution and often lead to neurasthenia, obsessions, and other health-shattering maladies.

Let us briefly refer to some of the common pathological expressions of sex. There may be a disharmonious atavism—what looks like a harking back to an ancestral state of affairs. Most cases of this in mankind seem to be due to an arrest of development, which may be the result of defective nutrition during the ante-natal life.

Whether through arrested development, or by a more literal atavism, or as the result of acquired neurosis, it does happen in our midst, often to our consternation, that there is a breaking down of what we regard as the normal relations of the sexes in a civilised community. In the weak-minded, in the criminal, or even in the old man, there may be an exhibition of violence or of coarseness, which is often described as below the human level, but is really a corruption of it.

Some of the vagaries of the sexual instinct may be ranked as due to a disturbance of the rhythm of life: thus there may be precocious expression of sexuality in young children, or a premature disappearance of it in adults, or

an exaggeration of it in old age. This probably occurs in wild nature as well as in civilisation. Thus in Herrick's very careful study of the European cuckoo, which leaves its eggs to be hatched, and its offspring to be nurtured by foster-parents, the suggestion is made that there is in birds a harmonious series or sequence of events linked to the reproductive function, such as migration, mating, nest-building, egg-laying in the nest, incubation, care of the young in the nest, care of the young out of the nest, and migration again. What may happen as a variation is a disturbance of the harmonious sequence: one chapter may be too long drawn out, as when two nests are built, or another chapter may be more or less suppressed, as when birds desert their nest.

Other sexual anomalies may be classified as exaggerations, like some of the extraordinary excitements occasionally incident on falling in love, or like a hyperæsthetic sensitiveness to erotic stimulation. Others are of the very opposite character—an unnatural frigidity and weakness of sexual desire. Or it may be that the instinct is awakened by abnormal excitations, whether sensory (*e. g.* of touch or odour), or psychical (*e. g.* by inflicting pain or by suffering pain). Again there are the peculiar phenomena of sexual inversion, or attraction to the same sex instead of to the opposite sex, which used to be regarded as an acquired viciousness or as the banal consequence of some lesion, but is now known to be frequently an innate perversion of instinct. This cannot be inferred

unless it is exhibited in conditions where normal sexual gratification is practicable. In some forms, the sexual inversion may be traced back to perverting experiences in early childhood; in other cases it can be referred, in part at least, to unnatural conditions, including in that phrase the absence of members of the opposite sex, of which our civilised societies, even at their would-be educational best, yield so many and such flagrant and disastrous instances. The so-called "uranist" variation is sometimes associated with other peculiarities, such as vanity, mendacity, hyperæsthesia, and a femininity in males, but it seems clear that there are occasionally uranists who are otherwise normal. From all such anomalies one turns with relief to the opinion of Sancho Panza the wise, who liked a man to be a man and a woman a woman.

REASONS FOR PATHOLOGICAL INSTABILITY. Even a slight acquaintance with the facts of the case—the unhappiness, the struggle, the brooding, the dread, the loss of vigour, the bad habits, the obsessions, the evil done to others—raises the question why there is in man this apparently great liability to pathological expression? Some of the reasons are not far to seek. In wild nature there is very little disease, unless we include parasitism. Unhealthy and defective creatures are speedily eliminated, and there is no hereditary accumulation of weakness or vice. In mankind this socially merciful selection is in great part evaded by society itself, and in many ways, from philanthropic to legal, all of which

we are now beginning seriously to criticise. Morbid tendencies accumulate. The artificiality and injuriousness of many human activities must necessarily provoke peculiar aberrations. The occupational factor in the production of sexual vice is well known. Just as man has to pay for his fine brain by liability to nervous break-down of many sorts, so he has to pay for that highly evolved emotional complex which we call "love" by liability to vice. "The lunatic, the lover, and the poet are of imagination all compact. . . ." Love at its best is a very complex and subtle thing; and just because of this it is very apt to go wrong. As Finot says: "The chaste, beautiful, and invisible Diana becomes the monstrous Hecate, the foe of light; Aphrodite vanishes in the voluptuous mysteries of Astarte."

Another point of importance is that sexual activity is seasonally punctuated in most animals, in most cases indeed suspended for the greater part of the year, whereas in man it has almost ceased to have any relation to times and seasons. This in itself is a great danger, and it is augmented when sexual appetite outlives its natural span of years. Man is, in fact, the most domesticated of animals, though these, dogs, cats and fowls especially, seem increasingly to acquire his continuous sexual possibility throughout the seasons. Nor is this altogether a wonder, since it is of the very nature of domestication to overcome the peculiar difficulties of the seasons to wild life. Moreover, this spreading of the breeding season throughout the year

carries with it the advantages of that season, in that enhanced intensity of individuality and life of which we have given ample instance in our opening biological chapters. Here, then, as everywhere, our difficulties of life are also our opportunities.

But there is probably a yet deeper reason, that the sex-impulse remains more or less apart from the general life of civilised man. Though it can be caught up into what is best in him, it remains in great part pristine, uncivilised, untutored. Just as the ultimate sexual functions, *e. g.* conception and birth themselves, are reflex and automatic, not controlled, so the sex-impulses retain their wildness. Even in the best of us there has surely to be recognised a volcanic element in sex, quite underlying the rest of our nature, and for that very reason shaking it from its foundations with tremor, if not catastrophe. There always must be some measure of reversion—and even of wholesome reversion—to the savage and the animal. The pathological enters when this reversion sweeps us too far. There is a terrible truth in Walt Whitman's image of man emerging "stuccoed all over with reptiles and quadrupeds," and in Tennyson's picture of "Reversion ever dragging Evolution in the mud."

Stanley Hall has done well to emphasise the degree in which youth is loaded with palæo-atavistic qualities. Many growths that we do not like seem to spring from "the partly lapsed and unreclaimed, partly virgin and never cultivated Bad Lands of the state of Man-Soul. . . . We are influenced in our

deeper, more temperamental dispositions by the life-habits and codes of conduct of we know not what unnumbered hosts of ancestors, which like a cloud of witnesses are present throughout our lives, and our souls are echo-chambers in which their whispers reverberate."

Even in animals we sometimes see an occasional occurrence of the abnormalities and diseases which occur in mankind. This is chiefly in domestic animals, for in wild conditions abnormality and disease are weeded out by natural selection. It is known, however, that hysteria, epilepsy, mania, and the like may crop up among animals, and the same is true of sexual perversions. Thus the parental instinct among animals may break down, in the madness of rut, or otherwise. Either parent may destroy or desert the offspring, or may act in a strange blind way under the influence of panic or pain. Mammals occasionally have false pregnancies; birds often incubate on nothing; melancholia may occur in connection with some bodily disturbance; and abortion among sheep and cattle seems sometimes to become contagious where no external predisposing cause can be discovered.

Quite a number of mammals display an erotic fury, especially if their sexual appetite is unsatisfied. Creatures ordinarily quiet become savage and dangerous to man, as in the case of the male elephant. Madly excited males may sexually attack other males or immature females. There may be satyriasis and nymphomania among the beasts, and the ways of monkeys are often repellent. It is

a noteworthy fact that the great majority of the records of sexual perversions in animals refer to captive or domesticated forms which suffer from repressive conditions.

THE WORK OF FREUD.—The most important recent contributions to the pathology of sex are those of Prof. Sigmund Freud; but it is still uncertain how many of his conclusions will stand even his own criticism. For like most progressive investigators he has from time to time modified several of his doctrines in the light of fresh facts. One of the general results of his work has been to show that some sexual agency operates to an unexpected extent in the causation of neurotic manifestations. Some of these, like hysteria and obsessions ("psycho-neuroses"), are traced back by Freud to erotic experience in childhood, to the influence of unconscious or repressed idea-complexes. Neurasthenia and anxiety-neurosis ("true neuroses") are referred to the present abnormal condition of the sexual functions of the individual. Hysteria, it may be said, is more psychic; and neurasthenia more toxic; but both have a sexual basis.

In nervous ("neuropathic") families there is often sexual precocity in the young children, even in the suckling, and there is often careless over-fondling on the part of the parents; constitutional weakness and precocious experience may thus combine with very detrimental results. After the third or fourth year there is the happy latent period of childhood, but the influence of early habits may last and may warp the whole adolescence.

It seems to be quite clear that repressions of the instinctive and subconscious sexual life of childhood make for evil, and that the therapeutic line is the culture of expression. Freud goes the length of saying that obsessions are in every case transformed reproaches which have escaped from the attempted repression and are always connected with some pleasurable sexual arousal of childhood.

The hereditary factor counts for much, but there seems no room for doubt that an ignorant and voluptuous mother, an uncontrolled or careless father, or a vicious nurse, or a precocious playmate, may give a twist to the child's life in its earliest years. But Freud clearly indicates that there is no justification for fatalism; it depends largely on nurture in the widest sense what shall be the issue of the universal conflict between the life-instinct and the love-instinct. And he gives us this sound advice as the practical conclusion of his astonishing psycho-analyses: Educate positively through love; avoid repressive measures, but aid the expression of the normal; let the child establish its own psychic and social individuality.

In regard to neurasthenia and the anxiety-neuroses which find so many expressions in modern life, such as irritability, nervousness, "fidgetiness," hyperæsthesia, digestive and cardiac troubles, Freud is not inclined to attach much importance to the direct influence of the "rush" of civilisation. Much more frequently the root of the mischief is sex-repression. There is, as every one knows, too long a period between the awakening of

strong sexual desire in adolescence and the possibility of regular gratification. Some are able to make this dis-harmony an opportunity for discipline in nobility, and they have their reward. In other cases, the attempted repression of chastity is biologically a failure; there is injury to body and mind, and sometimes the fixation of an infantile condition. An artificial substitute may be found for the repressed sexual gratification, and the result is pitiable. In other cases the outcome is neurasthenia due to a condition of the nervous system induced by excessive masturbation, or more spontaneously from frequent nocturnal emissions,—which in moderation are to be regarded as a wholesome safety-valve. In yet other cases, the solution is taken in sexual gratification before marriage, which may result in the same neurasthenia, or in sexual disease, or in ethical and social disaster.

But while the hot-blooded youth may land himself in neurasthenia, it is more characteristic of a maturer age to suffer from "anxiety-neurosis." If we understand Prof. Freud aright, his view is, to put it concretely, that what is called the result of "overwork," for instance, is often the result of a stifled or neglected sexual life. The "anxiety-neuroses" which make many people a little "queer" are attempts—often very curious—to get at substitutes for the omitted specific action which should follow sex-excitement. The "anxiety-dream" is the representation of a suppressed or repressed sexual wish, but even in the dream the sexual factor may have an entirely non-sexual expression.

The "anxiety-neuroses" may be the results of sexual repression, or of some sudden confronting with the facts of sex (a strong argument for some common-sense awareness of what the continuance of life implies), or of impotent husbands, or of frigid wives, or of diminishing potency associated with increasing lust, and so on. A dammed up libido, as Dr. Hitschmann says, hunts out for a weak place and breaks through, expressing itself in neurotic "substitute gratification." But again, Freud ends with the hopeful note of all those who have worked towards an increased control of life, maintaining that degeneration and nervousness are not in any way inevitable results of cultural progress, but excrescences which are to be avoided.

Medical experts sometimes point out that the hysterical neurosis of the unmarried may be due not so much to unsatisfied sexual desire, as to the absence of aims and interests sufficiently real to take their attention off themselves. According to Féré, sexual preoccupation in both sexes is not necessarily an evidence of particularly strong sexual needs; it may be the expression of degeneracy. What is blamed as a cause is thus sometimes only a symptom. For what cause of degeneracy equals that of unemployment? and this for rich and poor alike, albeit operating in slightly different ways.

GENERAL CONSIDERATIONS.—Anticipating somewhat, we may suggest some general considerations which should be borne in mind when we stand aghast at the prevalence of sexual vice. After the worst has been seen,

it remains a fact that there is in our midst a strong stream of clean living and clean loving. There is, after all, a large body of men and women of good will, whose whole bent is towards wholesomeness and healthfulness. Again, diseases, dreadful though they be, are not mysterious and fateful, but simply derangements of the ordinary functioning of life, of the up-building and down-breaking that continually goes on in health. They are not vengeance inflicted wholly from without, but consequences arising deeply from within, and they are not therefore to be met with mere submission, but with contest for control; they are not to be endured merely but cured, cured for the race, and at least palliated for the individual. Without this attitude of contest, defiant of the angry gods, and ever re-expressed through the ages—in literature from Prometheus on his rock to Henley writing his Infirmary Ballads, and in the medical and surgical arts from Asclepias and Hippocrates to Jenner and Simpson, Lister and Ehrlich, we should never have had any medical science at all. And it is in no small degree to hindrance from converse errors maintained too largely even to this day—on one side by moral and religious teachers, as on another by immoralists—that is due the slowness of our advances in sexual and psychological medicine. These have now, as of old, to be organised into hygiene—hygiene material and physiological, mental and moral—and this is already much in advance of public appreciation and application of it.

Just as disease, then, for the physiological

physician, is metabolism which has got out of time, out of place, and out of proportion, so sexual vice is the fallen state of virtue, and is not to be regarded as some mysterious and catastrophic intrusion.

Another important consideration is hidden in the conventional euphemism which calls sexual vice "the social problem." Such indeed it is; for just as certain diseases, like lead-poisoning, are occupational or environmental, so sexual vice, like "drinking," is in some of its expressions bound up with injurious occupational and environmental conditions and with apparently unrelated social deteriorations. Sweated labour fills the ranks of prostitution; and its crowded living-rooms blunt the sense of decency and stimulate precocious sexuality. In all cases, of course, the attempt must be made to distinguish between the casual and the chronic sinner, and between a viciousness that is inborn and a viciousness that has been acquired.

The social aspect of rebellion against the conventional régime of repression must always be kept in mind. Sexual gratification outside matrimony cannot be abstracted off as if it were a purely personal and physiological episode. According to the form it takes, it has a train of consequences—personal, domestic and social. There is the risk of venereal disease which may, and too often does, pass to wife and children, or break out anew in later life as general paralysis, again often with family ruin; there is also the risk of induced sterility; and beside these still comparatively personal results, there is the

inevitable complicity in sustaining a horrible social system. There is the baseness—at best base thoughtlessness—of seduction; there is the birth-stain of illegitimate children, and the misery so often brought on their mother. There is the personal and social rotting that so often follows the dissimulation and meanness of adultery. And so on.

In regard to the risks of repression it cannot be truthfully said that there is unanimity among experts. According to Freud, for instance, there is for many a great danger lest the dammed-up passion seeks out a weak spot and breaks through into neurotic substitute gratifications. He admits that conquering through sublimation and the transference of the force of the sexual instinct from sexual ends to higher cultural aims may succeed in some, while in others it leads to neuroses or some other injury. Féré, on the other hand, looks forward without alarm to an increasing control of sexual appetite, to an "adjournment" of sexual gratification till after marriage. No general rule can be laid down, but it is safe to say that most men would be none the worse, but all the better, of greater self-restraint; and this not only in deed, and in word, but also in thought. Just as the ancients were mistaken in regarding chlorosis as a *mal d'amour*, so the doctrine of the evil effects of chastity requires very careful criticism. It is certain that continence neither injures the reproductive organs nor the sentiment of love, and Féré goes the length of saying that "there is no pathology of continence." As the historic religions

have especially shown, there may be a high culture of continence, and this of wide applicability; despite all that may be said of its limitations or its failures.

CHAPTER VIII

PROS AND CONS OF SEX-EDUCATION

The control of life—Objections to sex-instruction—In favour of sex-instruction—The general character of sex instincts in man—Instruction by parents—Instruction in school—Modes of instruction—Cautions—Education and sex.

THE CONTROL OF LIFE.—The idea of the biological control of life, which had its first theoretical basis in Darwinism, found epoch-making illustration in the achievements of Pasteur. He showed that the days of folded hands and resignation are over; it is Man's prerogative to use science so that he may enter more and more fully into possession of his kingdom. Pasteur and his successors—men like Lister and Koch, Bruce and Ross—have given object-lessons on a grand scale, illustrating the truth of Comte's great saying: "Knowledge is foresight, and foresight is power."

As a practical corollary, believing that science is for the control as well as the illumination of life, believing that forewarned is forearmed, we give definite instruction to young people in regard to health and disease, foods and poisons, exercise and rest, and so on. As the results are well known to be useful, the question rises: Why should we not apply the

same method in regard to sex-hygiene? We instruct youth in regard to the digestive system and the skin, the nervous system and the muscles, but the reproductive system is tabooed. Why this conspiracy of silence? Is it not a loss that even the long used "Elementary Physiology" of so great, and in other respects fearless, a teacher as Huxley, should have practically assumed that physiology is sexless?

OBJECTIONS TO SEX-INSTRUCTION.—There is, perhaps, an inhibitory awkwardness—largely a false shame—in regard to all that comes within hailing distance of the lusts of the flesh; but along with that there is some sound educational perception of the risks of bringing sexual impulses into the focus of consciousness. Let sleeping dogs lie! The answer to this objection is that all care must be taken not to anticipate interest, that the instruction must be graduated, and that in the case of boys the facts of sex obtrude themselves into consciousness at an early age. The dogs are not sleeping. If correct information be not given, there is likely to be a haphazard acquisition of what is often inaccurate and discoloured. There is also in the conventional reticence a not unwholesome recognition of the mysticism which has always surrounded the physical basis of love in general, and has in particular enveloped woman, especially in her progress from puberty to maternity—a mysticism which has contributed much to helping man up the steps from physical desire and fondness to the higher sentiments of love.

The answer to this objection is that it may be possible to conserve the mysticism without withholding the instruction which seems to be practically desirable. It touches the imagination, for instance, to show that the sex-impulses have had a long evolution. It may be possible to suggest that in the control of sex-impulses there is an opportunity for disciplining body and mind, and enriching the whole personality. In any case, it can be shown that the recognition of a certain mystery in sex rests on its sacredness, not on there being anything shameful about it.

It is often said that in previous generations men and women got on very well without this "fad" of sex-education. But the question is, whether they really did! It has to be remembered, moreover, that there has been in the last half-century a marked weakening of family control, and that in manufacturing centres especially the emigration from the home begins very early. Religious control has also slackened throughout large sections of the population. And as to the alleged absence of sex-instruction in the past, it should be remembered that in many primitive peoples there are elaborate initiation courses.

IN FAVOUR OF SEX INSTRUCTION.—The question before us is whether it is desirable to try to instruct young people in reference to the facts of sex. No one will wisely give a dogmatic answer to this question, for the basis of experiment is still very narrow. The question is raised because there is so much evil in connection with sex—foulness of thought and speech, pruriency, indecency,

adolescent troubles, incontinence, sexual vice, and "immorality." These evils do not necessarily form an argument in favour of sex-education, for it is possible that we might make bad worse. And although some teachers have put on record that the sex-education they give has been rewarded, it is possible to answer that they were peculiarly gifted, or that they worked in peculiar conditions. And although notable workers like Miss Jane Addams of Chicago, whose *Spirit of Youth in the City Streets* we cannot too highly recommend, have recorded the statements of those who have gone badly astray, that it would have been otherwise "if they had only known," it is possible to answer that this is a common form of excuse. Yet these cold-blooded arguments against doing anything at all are usually whirled away when we come into personal contact with disaster, and are forced to ask ourselves whether fore-warning might not have been a safeguard.

If saying nothing were working well, most of us would be inclined to let well alone; for none of us like speaking about sex, and there is certainly danger of giving instruction unwisely and of breaking in on the adolescent's reserve of mind. But the method of saying nothing is not working well; so that it seems that more experiment in the line of sex-education should be made. Prof. Stanley Hall emphasises the advantage of getting the right presentation first, preoccupying the mind with a dignified and frank outlook. Otherwise the chances are many that the adolescent gets hold of erroneous information

and assumes a wrong point of view, both often referable to sexually perverted or precocious acquaintances of whom there is always a small percentage in every community, and who seem to have abnormal success in infecting others with their own unwholesomeness.

The mental content covered by the word sex is so intimately personal that there is truth in what some have said in regard to the danger of bursting into the youth's reserve of mind. The danger must be admitted especially in reference to girls; and the answer is that we must learn to give without violence such instruction as experiment proves to be most useful.

THE GENERAL CHARACTER OF SEX INSTINCTS IN MAN.—It is important to notice that while man has strong, innate sex-impulses, the associated sex-instincts are general rather than precise. Among some of the lower animals, such as Insects, where instinctive behaviour prevails, there are often very definite reproductive instincts of a complicated sort, which sweep their possessors through an intricate routine of courtship, pairing, and preparation for the young—often never seen! Among backboned animals also (see Chapter VI) there are numerous examples of complex reproductive instincts, though they rarely exhibit the same degree of intricacy that is seen in many insects. In man, however, the reproductive and sexual instincts remain very general. This is perhaps because of man's language, prolonged family life, and social traditions, through which the need of very precise instincts has

been superseded. In any case, the fact is that we have, in regard to sex-functions, very little instinctive knowledge of what various phenomena mean, or of what is normal, or of what is to be carefully avoided. A boy or girl may slide into bad sexual habits without being well aware of what is happening. If nothing "straight" is ever said by any one, it is difficult to deny the justice of the sufferer's reproach: "But you never told me anything about that!"

INSTRUCTION BY PARENTS.—If it be granted that there should be more experimenting in sex-education, the question arises: Who is to instruct? One thinks first, of course, of the parents, who have the greatest responsibility and stake, who have, also, in many cases the invaluable organic sympathy. For those of tender years, every one will agree that the wise mother is incomparably the best counsellor. But when we face the present-day facts of the case we cannot believe that the solution of the problem lies wholly with parents. It seems that few parents give any sex-instruction to their children, though an increasing number are using some of the excellent little books which have been written in this connection both for parents and children. Few parents are able to utilise the indirect, impersonal, biological approach which seems to be more effective than direct advice. As with religious instruction, many parents who feel their responsibility keenly are too shy to be of much direct use to their children. Moreover, the personal aspect of the case rises too obtrusively in a boy's mind when his

father speaks to him on the subject of sex. There is, again, the serious fact of very early emigration from home and home control. It is plain, too, that those children who most need definite instruction and warning, because of hereditary predisposition to go wrong, are least likely to get it. In ideal conditions, no doubt, the sex-instruction should be given at home; but, as things are, it seems certain that it must also be attempted in school. We have referred in the Bibliography to some books which may be useful to parents who are able and willing to discharge for themselves the duty of instructing their children in regard to the continuance of life and the facts of sex. It goes without saying that, without ever mentioning sex, many parents do the best of services for their children by garrisoning their minds with good examples and ideals of self-control and healthy-mindedness, thus preoccupying the heart "out of which are the issues of life."

INSTRUCTION IN SCHOOL.—As things are at present, it appears that the sex-education will have to be given in school, and that it should be linked on to such subjects as nature study and biology, human physiology and domestic science—the linkage being left to the teacher's discretion. As the gift of speaking effectively about such a secret and sacred thing as sex is probably rare, it must be left an open question whether the instruction is to be given by the headmaster or headmistress, or by the class teacher, or by the teacher of biology, or by the school physician, or by the loan of books and pamphlets.

It is a fact that there are teachers—both men and women—who at present give sex-education consummately well, and to whom the pupils express lasting gratitude. It is obvious, of course, that sex-instruction may be given blunderingly, just as religious instruction may be given profanely, but teachers are not falling off in efficiency or goodwill.

MODES OF INSTRUCTION. — What forms should the sex-education take? It will need to be varied with reference to different sections of the community, and with reference to the difference between boys and girls. The problems are indeed universal, but the counsels given must be adapted to different conditions and possibilities. We cannot think for a moment of anything like a doctrinaire scheme of instruction, coercively imposed from without. Not only because this means fixing what should be left elastic, and saying farewell to spontaneity and enthusiasm, but because it must be confessed that we have not sufficiently consulted the child. If we are ultimately to succeed we must first be humble enough and scientific enough to try to find out patiently and sympathetically what the person most concerned thinks about all this. This inquiry has begun, but it has not gone far.

What seems practicable is to ask that *something* should be done along a graduated series of educational methods, leaving it to the discretion of the teacher to decide how far along the series it may be profitable to go. We therefore submit a tentative graduated series.

(a) Much may be done in adolescence by developing external preoccupations and interests and real responsibilities; by opening up paths of legitimate excitement—in work and play, in art and wholesome adventure, in dramatic and musical exercises; and by making certain that there are disciplines in enduring hardness—for instance in scouting, in boys' brigades, in girls' guildries, in climbing and swimming and exploring. As Stanley Hall says in a sentence: Develop motor activities. It seems good sense that in the practice of these the sexes should be generally separate, but sometimes together.

(b) General assent will also be given to a second proposition—that we should develop all forms of education (religious, ethical, and imaginative) which fill the mind with noble examples; which exalt the sentiment of human love by associating it with the chivalrous, the poetic, and the romantic; and which set a premium on self-control, courtesy, mutual respect between the sexes, and healthy-mindedness. In short, we must hitch the sex-wagon to a star.

(c) While agreeing to respect the natural instinct of reserve in regard to sex, teachers will probably admit that it is not a very dignified device to shy off from the facts when they present themselves in the course of studies in history and the like. "Bowdlerism" defeats its purpose. What is to be suggested is that mystery is observed because sex is sacred, not because it is shameful. Without drawing morals in any wooden way it is surely possible to suggest from history

and biography that control and chastity make marriages happy and nations strong, while the *corruptio optimi* is already hell.

(d) Without spoiling good botany and natural history something may be done to remove the facts of sex and reproduction from their human and personal setting, to show them in their natural setting—which often has an extraordinary charm—and to disclose from the long history the gradual ennobling and enrichment of what we call love. Even nature points the way to the stars, and most teachers who are interested in the life of plants and animals are agreed that the study puts an end to morbid inquisitiveness and lets the open air into the whole subject of sex. “For him to whom sex is impure there are no flowers in Nature.”

(e) Beyond clearing-up the subject of sex through the medium of sound botany and zoology, many will at present decline to advance. Others, who are perhaps more thoroughly acquainted with the facts in regard to the troubles and mistakes often associated with adolescence, are convinced that, for boys in particular, it is necessary to go further. The medical inspection of school children, though still incipient, has done good service in showing how much suffering is avoidable, and the idea at least has taken possession of the public mind that, as Dr. Leslie Mackenzie puts it, “the child shall have, at every stage of his growth, his maximum chance of attaining to physiological fitness.” The realisation of this ideal, already in progress in individual inspections, in school

clinics, and in words of counsel, must include attention to the sex-life of the adolescent. Some headmasters have straight talks with their boys, warning them against the dangers of adolescence; others lend books or tracts of good advice; in many cases, as it seems to us, the most effective counsel will be that of the school-physician, who can speak with most authority and without embarrassment.

CAUTIONS.—It appears to us that with sex-education in school we shall do well to hasten slowly. (a) Society does not move *en bloc*, and a frankness which seems quite natural in some communities will be keenly resented in others. Whatever direct instruction is given, it must be carefully differentiated. In some of the shameful conditions of life that still obtain in our midst, the children have nothing to learn of the seamy side of sex; what must be done is to show them that there is another side.

(b) Another point is that while parents can do what they like in the way of sex-instruction—which is usually nothing—school teachers must move cautiously. They must make sure that they are carrying the parents with them, and in some cases this has been done with the happiest results. As in regard to religion, so in regard to sex, there are some who deny that the education authorities are justified in intruding into what ought to be a parental responsibility.

(c) It seems quite plain that girls require much gentler sex-education than boys. By nature and by tradition they have a deeper reserve, and the difficulty cannot be ignored

that, as things are at present, many of them will not marry. It may be dangerous, therefore, to bring to the focus of consciousness instincts which often remain normally at a subconscious level.

In regard to *quite young children* (under twelve), we venture to formulate certain requirements or desirabilities. Any instruction in regard to the continuance of life should arise out of nature-study, from the experience of pets—rabbits and doves for choice, but also poultry, and also from cat and kittens, bitch and puppies; and why not from the experience of farmyard visits, with their innocent familiarity with the ways of its domesticated creatures? While there may be legitimate silence or postponement of answer, there must be no shirking or beating about the bush once an answer has been embarked on. Nothing must be said which will have to be unlearned afterwards, for no one can do a child much greater harm than telling it something which it will afterwards discover to be untrue. While some instruction must be given nowadays, if we are not to fail of our duty, it is safer to err in saying too little than in saying too much. As children of the same age vary greatly in development, and as there is great risk of anticipating interest, the instruction as regards mankind should be indirect and unobtrusive, so that while it is of use to those who have reached the stage of natural interest, it will hardly be noticed by those who have not. While there should not be any suggestion of any shadow of shamefulness over the subject, it must be treated

with reverence and as a great mystery—as it certainly is.

It is with no unconsidered lightness that we advise that an attempt should be made to give children a frank, unashamed, and reverent outlook on the essential facts concerning the continuance of life. We do not forget the solemn warning that it were better for a man to be cast into the sea with a millstone round his neck than that he should cause an innocent child to offend. But the child may be caused to offend by cowardly reticence as well as by too great outspokenness. There is a time to speak and a time to keep silence, and all sex-education must be differentiated with reference to particular cases. It may be agreed, however, that whether the sex-instruction is direct or indirect, through hygiene or through nature-study; whether it is given by the parent or by the head of the school, by the science teacher or by lending booklets—care must be taken not to anticipate interest, not to excite, not to say what is untrue, not to teach what will have to be unlearned afterwards, not to make false mysteries (such as dusting a stigma with a pollen-laden feather might dispel), not to deal with the pathological, not to frighten, not to pretend that men and women are angels; and, above all, not to say too much.

EDUCATION AND SEX.—Let us again attack as a common misunderstanding the idea that the ordinary physical and intellectual life and education is one thing, and sex-life and education quite another. They interact; and

this in every possible way—the type of physical and intellectual life and education normalising or denormalising the sex-life, according as we manage it, and so conversely, the sex-life ennobling or deteriorating the whole general education in its turn.

We have been considering how young people may be educated in regard to the facts of sex; but we must now turn the problem round, and inquire whether the facts of sex do not point to the need for a re-consideration and re-adjustment of our educational routines.

In the adolescence of the organism, during which in mankind, the voice of education is clamant, we have already recognised a period of rapid growth and redifferentiation. There is increasing stability and yet, for the time, great instability; there is great vigour, and yet great “slackness”; it is not a period of the inclined plane of life, it is a period of taking steps. This means that the adolescent should have plenty of rest and plenty of play and plenty of broad human interests. But when such physiological ideas become considered in high places, what will become of some of our most cherished present school and university arrangements—their leaving certificates, their entrance and scholarship examinations, with their standards “working up” as these are all so rapidly doing?

If this progress in “raising the standard” be continued during the next generation in anything like the same way it has gone up in ours, we shall have practically a recrudescence of the ancient memory contests of the Finns, combined with the Egyptian Trial of the Dead.

Of course, without the poetry of the first, or the religion of the second, but with a combination of their respective toil and terror. Indeed, do we not already inflict far too much of this intellectual strain, this moral anxiety, upon many a sensitive youth and on far too many conscientious girls; and though we justly shudder at the ancient ritual which could pass a child through the fire to Moloch, are we so much gentler or wiser in passing our children wholesale through examinations for Mammon? And though we have not as yet materially flattened down our children's foreheads in deference to the established fashion of certain old-fashioned tribes, do we not more seriously deform them in both compressing and depressing their growing brains?

As from the biological standpoint of this volume, we support the woman's cause, and the child's, so, perhaps above all, we plead for the adolescent, both youth and maid; and we claim a brief hearing from parents, from teachers and examiners, both secondary and higher, and from the authorities to whom these parents and teachers alike have for two or more generations been increasingly abandoning their responsibilities and powers.

There are, indeed, increasing and hopeful signs, even in the world of examination (as notably for the Rhodes Scholarships and the Navy), of the subordination of exclusive book and memory tests to a fuller and more all-round type of examination; so why may not "*Estimation versus Examination*" be made the slogan of a needed general revolt? Against this, to do the said authorities justice, the

resistance would neither be enthusiastic nor strong, in fact the surrender more speedy, more complete, more willing even, than as irate besiegers we commonly realise.

Hence—without, of course, here entering into educational details beyond our present province—let us re-emphasise the significance of adolescence as the critical phase between childhood and maturity; and this for body and mind, for soul and spirit : and plead here, if possible more fully than even Stanley Hall has done, for a reconsideration of that whole scholastic and academic treatment of this, which has been organised almost entirely in relation to the equipment of knowledge, or at most to the exercise of certain intellectual powers; and, we believe, with bad psychology even for these too highly-rated fragments of the problem, themselves too much dissociated in practice.

Only within comparatively recent memory have our boarding-schools ceased seriously to starve the growth of their boys and girls at the very period when an ample diet is most necessary; and even parents, who now know sugar to be no luxury but a needed muscle food, are still dubious of fruit ! Still on the whole, the hungry boy now gets fed; but he is still apt to be starved of his own measure of sleep. So let us support the family and school doctor in prescribing sleep as a first treatment for the sleepy; and even rest to those we are apt to call lazy, when they are coming through the languor of physical growth, or that yet more pedagogically exasperating dullness and inattention which is often but a symptom of

the mysterious and difficult maturation of brain.

Taking our own cities of Edinburgh and Aberdeen, as certainly among those of largest proportional educational quantity and endeavour—and surely sometimes even quality, as the world goes—though every one knows the tales of boyish adolescent backwardness of men of genius, like Hume and Scott, what of their opportunities of peaceful interior development would they now be allowed in our day?

It is, of course, replied to such arguments that genius is uncommon and cannot be provided for. But this is prescientific; for genius is common until wasted. Every normal adolescent is something of a genius; and our problem is to encourage his spark, not smother it under lessons, dull it with constraints, or weary it out of use or into evil through long terms of drudgery, weighted by impending crises, and scourged by approaching fears!

Examine as you will later in college life, or at its close, and correspondingly for apprenticeship: but leave these youngsters in their period of metamorphosis far more largely than at present to nature, who never has hastened her Psyche to unfold her wings by shaking up the chrysalis.

True, our human metamorphosis is in obvious external ways not thus passive, but who yet knows but that some of its finest elements—those of the essential Psyche—may be? Consider some of these: conveniently in our modern world take Art and Science.

First, science, both as simpler and more obviously concerned with the much-respected equipment of knowledge; and for our own science of biology recall the "grand old men," second surely to none in history—Darwin, Wallace and Hooker so lately with us, Haeckel and Weismann happily still here. Records of adolescent distinctions in the ordinary sense are not much evident—the very absence of them much more so! But these, like all true naturalists, were boy-naturalists, having acquired the essential feeling of their subject in early years before adolescence, and escaping conventional instruction—at least, till they were mature enough to take it for themselves.

So conspicuously it is and has been with the great artists who have attained long life. They remain great to the end; and this we believe, so far as we can read their biography, is in association with early aptitude and effort, and adolescent choice and opportunity in developing it; whereas (and here is an essential point) our secondary artists and scientists are not necessarily secondary, but largely those who have been more or less starved of their proper opportunities in childhood and in adolescence; and who have thus begun to learn too late, after the adolescent growth and plasticity had been wasted and stiffened, in our conventional but for them irrelevant ways.

Moreover, generalising such biographies yet further, though, after efforts even late begun, considerable or even high productivity may be obtained during the age of maturity, this tends to go off with the first or second decline of vigour of sex, as with the advent of the

forties or fifties, leaving on the whole only those who had the right pre-adolescent beginning and adolescent opportunity still efficient after the great climacteric period of the early sixties.

This hypothesis, even difficult to express, is we admit, also still fully to verify; yet we submit it, both as giving cause to think of our pedagogic process, and hope of its improvement. This, too, at the very highest levels, for what we have said for art and science may also be justified; and perhaps not less clearly from the lives of men of letters.

And must not all this apply perhaps even more plainly to woman? Does not she need an adolescence of even more rest and happiness, and even less strain? What, too, of her period of highest development?—not even of young beauty, divine though its phases be and each entrancing in turn, from Artemis to Aphrodite, and thence to the bright perfection of Pallas, to the full-blown rose of Hera. Beyond all these it is the ageing Demeter, the matron, corn-mother and bread-giver, who most fully presides throughout civilisation; while beyond her again, past the later climacteric, and in full old age, there does at times and should more often arise that wisdom of the Sibyl, which penetrates beyond even that of the sage.

Such high types of woman's originality and intelligence, though rarer than those of the able man-educated woman one increasingly meets, are natural and normal for all that, since they remain also more organically feminine, with their keen and subtle wits

more directly rooted in woman's wit and in mother-wit; their broader than masculine common-sense, their warmer and more varied sympathies being again developments of mother-sense and mother-kindness.

May we not learn something here from Catholic tuition, with its far more emphatic idealism of woman, and its tradition of education accordingly? Are our well-established girls' schools and women's colleges, with their predominant examinations and ball-games—so curiously replacing Mangnall's "*Questions*" and "the use of the globes"—really as complete and final as their governing bodies and their prize products are wont to proclaim? May they not make their next steps in progress by for a moment turning backwards? For thus, in the first step, they would recover the meanings of the despised old "globes" and "accomplishments"; which were alive in the time of the great ladies of the Renaissance, who sold their jewels to fit out Columbus on his voyage over the sphere, and later adopted the new astronomy before either church or universities; and who not only helped on the new learning, but the vernacular literature and the Renaissance arts as well. How did they accomplish all this? Because at that period of commanding masculine intensity—with men again like their Roman exemplars, lords of action, and masters of thought with Plato and the Greeks—they were themselves correspondingly evolved and intensified as women; and thus, more than ever in history, and for good as well as evil, they made themselves queens of life.

For though at its best these Renaissance ladies excelled our own, despite our better established "educational advantages," in sheer intellectual attainments, were not these also associated with an intensive ideal of feminine perfection? Men were then not a little inspired by the heroines of antiquity, and above all by the Goddesses and Muses of its ideals. If so, may we not do well to recover these, and not merely see progress in subjecting women to the more masculine educational influences and ambitions of to-day?

Consider now even a second step backwards, back to the convent and its school. May we not thus come to understand more fully, to judge more patiently, that respect which even some of our own scientific and free-thinking friends in other countries still have for it, with preference even for their own daughters? In countries so Protestant as ours, none need fear any wholesale acceptance of what seem to us their limitations. But may not the sympathetic study of them help us to abate some of our own converse limitations?

Return, however, to education as we find it at home among ourselves. A notable sign of progress is surely that of the rise of colleges of Domestic Economy, with their vast crowds of girl students—in Edinburgh alone some four thousand, and this with but a few years' growth. Moreover, these, from modest beginnings of household management, are growing up—prominently both in London and Edinburgh—to claim academic rank, as a new and true Faculty of the University.

The primary schools, too, are showing the same tendency; while special schools of nursing, of health and gymnastics, and above all of child-care and mother-helping, are increasingly commanding the respect and attention of educationalists.

Parallel to the admirable revolutionary outbreak of boy-scouting, there is growing up for girls a corresponding novitiate of domesticity; and though the first be sometimes reproached as too primarily addressed to the youthful hunter and savage in every boy, and the latter as sometimes too much tending to make a Cinderella of the girl—these are doubtless but transient limitations and exaggerations, and may soon help each other towards a more and more human completeness. Each of these methods, even if still somewhat crudely expressed, is a return to nature, to human nature, to sex-nature; and not simply an escape from that dull overpressure of mere second-hand knowledge, which has too long been the fetish and the curse of schools, but a recovery of the real first-hand knowledge, which, however simple, readily grows to more. With boys made more courageous, and girls more gentle, we cannot surely but see our way to the next step—boys also more gentle, girls more courageous too. Although we believe, and would fain realise in education, that “virtue” should become increasingly the same for both sexes, it is well not to forget the differing meanings of the old Latin word *virtus*—as of predominant courage and vigour, affection and purity, for the sexes respectively. It is

by accepting and starting from these differing bases in sex and life—different in the childhood of the race and of its individuals—we may thence best advance, and so make virtue, in all its modern sense and its ethical values, more common to both sexes: never indeed identical, yet more and more subtly intermingled, and towards higher and higher flower.

Yet let no one imagine that we would debar the adolescent girl any more than the youth from the university; nor propose for any an adolescence of mere irresponsibility or idleness. Our ideal is one of novitiate, and with fuller and more varied opportunities and interests; and this on one side indeed of arts and graces, refinements and pleasures—of youth enriched from nature and science, poetry and literature, music and dancing, yet also rich in opportunity of what valiant lad and generous girl alike desire—ay, and more deeply—opportunities of enduring hardness, of sharing the realities of the world's labours. If there be anything in the progress of civilisation—and are there not grounds for believing that we are just entering upon a new uplift of civilisation from a too squalid and palæotechnic industrial age to a finer neotechnic one—from a civilisation that is too harshly determined by steam, and mechanical industries, by markets, wars and mammon, to a finer age refounded on electricity and striving towards finer industries and arts, hygiene and education, nobler homes and cities above all? If, as is the present fact, the electric age, the housing age, the civic age, a time of moral and

intellectual genius and of creative art, be all waiting for the better education of our boys and girls, why not begin more fully its refining novitiate? This nobler city is not that around us, not that of the old-fashioned economists, with their "necessities, comforts, and luxuries," respectively adjusted for the deterioration of lower, middle and upper classes—as the "populace, the philistines and the barbarians" of Matthew Arnold's enduring sarcasm—but of life and industry reorganised towards the uplift of them all. Art and science, health and sanity, morals and citizenship are all increasingly becoming seen to be rooted in the realities of labour; and the present lack or failure of them is seen to lie in the commonly contrasted drudgery, exploitation and idleness which are the curse of the existing classes. Thus there appears the necessity of nature-education, and of occupation-education, for one and all: and hence it is that our boy-scouts and girl-guides, with their present limitations, are in advance of the traditional schools, with all their advantages. For Baden-Powell is among the prophets; though that need not prevent others from having their turn.

With this approaching renewal of social health, the much-needed remoralisation of the sexes will correspondingly be advanced, and this largely in the natural ways of simpler communities—thus abating our present anxieties, perhaps even abating the necessity of each of our purifying and even prophylactic endeavours, urgent though we see all these to be to-day.

CHAPTER IX

THE ETHICS OF SEX

The greatness of love—The evolutionary outlook—Man's distinctiveness—Self-control—Healthfulness—Healthy-mindedness—Clean living—Two standards—Facing the facts—Ideals—Courage and kindness—In summary.

MANY difficult moral problems are involved in the fact of sex and in the relations of the sexes in mankind. What of masculine self-control, of chastity before marriage, of the possibility of a uniform standard for both sexes, of faithfulness after marriage, of sexual temperance, of the rights and wrongs of divorce, of enforced celibacy and spinsterdom, of the penalties imposed on breaches of existing conventions and laws, of the finer relations between the sexes and the moral evolution of these to higher issues? We cannot do more than suggest certain considerations to be borne in mind in facing these very difficult problems.

THE GREATNESS OF LOVE.—Beside the love of a mother for her children, comes the love between man and woman, one of the great things of the world, one of the mainsprings of life. It is a transforming force in the individual life-history, like an enthusiasm or like religion. It is a spring of conduct which has prompted much of the heroism and hard work of the world. If we spoil it, or make little of it, we lose one of the great possibilities of happiness and uplift. If we degrade it, one of the lights of life, a very "candle of the Lord," goes flickering, guttering out.

THE EVOLUTIONARY OUTLOOK.—The sex-impulses, at once the glory and the shame of mankind, have an inconceivably long history behind them, and spring up within us with a tremendous organic momentum. Here we have at once warning and encouragement. Warning, because for most of us there are brutish elements in our sex-impulses, which are badly out of date, and which, if allowed to develop, will be as tares strangling out the wheat. When they become insidiously dominant we have what occupies a considerable part of the terrible records of sex-pathology. Few men escape paying a tax for their great inheritance; and the tax often takes the form of some distressing atavism of the flesh. It is the case, however, that the ape and the tiger do die down, if we do not feed them.

But besides warning there is encouragement in the evolutionary outlook. Looking backwards we can discern that sex-love has evolved in fineness without losing in intensity. It has become more complicated, more subtle, more psychical, more lasting.

Up through the animal kingdom we see a crude stimulus being replaced by physical fondness, and that being adorned by æsthetic embroideries. Then we find the sexes, in some of the birds and mammals, remaining gladly together throughout life, working together in harmony. Now, there is no doubt that the human ideal of love is one in which all the finer threads of prehuman sex-attraction (of the delicacy of some of which the protagonist of man's apartness and perfection has no notion) are interwoven

and sublimed—physical fondness, æsthetic appeal, affection, intellectual sympathy, and some capacity of working together. We are encouraged towards that ideal by knowing that the trend of evolution is in that direction. For most men, however, there is a long way to travel before they get free from the risk of a reversion which so often drags their evolution in the mud. Perhaps man's difficulties have been increased by the absence (or more commonly by the loss) of any very definite periodicity in his sexual appetite. We see the same dropping out of periodicity in domesticated or artificially sheltered animals, and we know how dangerous it is.

MAN'S DISTINCTIVENESS.—Man's affiliation to the rest of creation must be kept in mind if we are to think rightly about sex; but let us hasten on to say that man's differences from animals are as important as the resemblances. For with man all things became new—sublimed in a rational experience. The primary impulses and emotions (including those of sex), the raw materials of morality, and the springs of conduct which man inherited from prehuman ancestors—all became new. This makes a world of difference. Man not only loves, but he knows that he loves. He thinks and speaks and dreams about love. He has ideas on the subject, and ideals to which he would make his love conform. He not only feels sex-impulses; he passes them, when he has got that length, under the review of his judgment. He has also, even in spite of himself, to think racially and socially, to consider the gratification of

his sex-impulses not only in relation to himself, not only in relation to another beside himself, but in their racial and social consequences, immediate and possible.

SELF-CONTROL.—Whether we look back upon the course of evolution and see that progress has been the reward of the controlled and strenuous types; or take instruction from the pathologists of the mind and learn how easy it is to slip below the rational and human level if the power of inhibition is weak; or read history and biography and the counsels of the wise—we reach the conclusion that self-control makes for individual and racial progress.

While some men have very strong wills and others have very subdued passions, most men of average flesh and blood who would live clean lives, need all the help they can get, it may be from religious and moral ideals, from artistic fastidiousness, or from a feeling of social solidarity. Sex-impulses rise with so much momentum within us, which of us is sure that he will stand? Counsel may be expressed in ethical or psychological, in biological or medical phraseology, but it always amounts to the same thing, and there is no other way. Just as we go into training if we are looking forward to some big effort, so for the critical trials of life we have to train in self-control, in enduring hardness, in doing difficult things, in going through with some task we do not like. Perhaps we may venture to say, however, that we should not think too much about this, but go at it cheerfully as part of the day's work. We are meant to

be artists in fashioning our characters, not hodmen. The general experience is unanimous that discipline in control of thoughts, words, and deeds helps a man to keep a rein on his sex-impulses. The ethical value of athletics and of exercises like climbing and long tramps is great. Without being a prig, the adolescent can keep always before him the ideal of vigorous health, which has a very close connection with morals. But it is not adolescents only who require discipline in control. Féré refers with a touch of scorn to those husbands who do not hesitate to inflict a new pregnancy upon their wives a few weeks after their delivery, and refuses to accept the apology that otherwise they must do worse. Those are not awanting, he says, who are able to respect the period of pregnancy and lactation, who are neither the worse of it nor unfaithful. Yet there is a risk that the increasing personal and political freedom of women may lead them to attempt to "force the pace" of moral evolution, demanding more sexual temperance than the average man can at present stand; but against that has to be set the desirability of coming to an end with a condition of affairs in which wives are not allowed the sovereignty of their own bodies. That this is wrapped up with housing reform and the like, is obvious.

HEALTHFULNESS.—Those who get a fair start and have not too hard a life know that a failure in vigorous health usually means that there has been slackness or indulgence or carelessness in some form or other, excepting the casualties of microbic infection, though even

this occurs in many instances because the organism was caught napping. Healthfulness is a very reliable index of moral condition—even in some of its higher reaches. Overworking is wrong as any other excess is; and the fact that it is not in itself pleasant does not lessen its hurtfulness. It always lowers the standard of health and weakens the first line of defence against evil. Therefore just as Prof. Stanley Hall speaks of religion as a great prophylactic against sexuality—a wise saying not to be taken superficially—so the biologist must say as much for healthfulness. Not, of course, that being in good form means exemption from sexual storms. But the hope is that the discipline of self-control involved in maintaining a high standard of physical fitness will help men to clean living. In any case it is certain that, individually and racially, survival is with the self-controlled.

HEALTHY-MINDEDNESS.—Complete health includes healthy-mindedness, and who would not rather be a cripple than have an unclean spirit? But how is healthy-mindedness to be fostered? We shall never get beyond the ancient counsel: "Keep thy heart with all diligence; for out of it are the issues of life." Many know "the expulsive power of a new affection," as Dr. Chalmers phrased it; many know also the value of preoccupying the mind with things true, honest, just, pure, lovely, and of good report. To garrison the mind with high interests and lofty purposes makes for safety.

To many comes the trouble that, through no fault of their own, they see obscene sights or

indecent pictures, or read lascivious passages, or hear ugly stories, which remain with them as pestilential memories. In such cases we must try to bear the unwholesome impressions out in a swift current of joyous adventure. And if they sink as foul things will, and rise worse than ever to the surface again, we must change the subject persistently, and do something active. But should they still persist, as they sometimes do, like blots in the brain, we must look at them fair and square, and squeeze the life out of them by understanding them and something of the unwelcome 'physiological power they have over us. As long as anything mysterious remains, they will return to us or we to them; so it may be helpful in obdurate cases to read up some thoroughly scientific book, such as Marshall's *Physiology of Reproduction*, and get a clean, clear view of the facts. But to read pathological literature because of some obsession is, we believe, the worst possible expedient.

CLEAN LIVING.—Most men with a sense of veracity will agree in confessing that the way of absolutely normal sex-experience is a very narrow way. Most have reason to fear, even when they are old enough to have learned wisdom. Even marriage may sink into monogamic prostitution. It is only a very perfect love that casts out all fear.

It is well-known that purchase of sexual gratification may be punished by disease—by gonorrhœa which may end in sterility, or by syphilis which may end in general paralysis many years afterwards. In these consequences there is much to fear. But we would

refer rather to something deeper—the fear of moral disease. Just because man is highly evolved, he is liable to many instabilities—hells to match his heavens. It is a great pity to lapse into self-indulgence, and a great pity to buy sexual gratification; but it is a greater pity when a man becomes sexually obsessed, when an evil habit grips his body and suborns his will, when his mind becomes preoccupied with obscene pictures and lustful purposes. Without becoming morbid, then, it behoves most of us men to entertain a wholesome awareness of danger—the kind of quality a good climber has habitually. Fortunate indeed are those who always remain gentlemen unafraid.

But there is a higher argument than that of fear, for every honest man knows that the controlled life in all its paths is the more efficient. “Behold the life of ease, it *drifts*; the sharpened life commands its course.” Self-restraint means struggle, but it is the honourable life and it brings a reward of higher happiness. Many an intellectual athlete has got rid of his sex through his brain, as a French saying has it. Féré, a leading authority on sex-pathology and hygiene, denies categorically that a man is ever hurt by continence, and affirms that he is always the stronger. This, at any rate, is certain: that a man will be happier all his life if he can come to his wife a passionate lover, with a clean record.

It must be borne in mind, however, that while anatomical chastity is a moral achievement, it is not the deepest virtue. The incisive declaration: “Whosoever looketh on

a woman to lust after her hath committed adultery with her already in his heart," expresses an even more searching standard, and modern science brings home to us the radical importance of our reflex thoughts and deep-down impulses, which appear to bulk largely in moulding our lives and the lives of those who may spring from us. Even our dreams betray us, though we are sometimes better (as well as worse) than they. For it seems well-established that a large proportion of dreams express the wish-fulfilments of repressed sexual desires.

There is a higher argument still—that man is a social person. No man liveth or dieth to himself, and uncontrolled sexuality cannot remain a purely personal vice. Indulgence in sexual gratification outside matrimony cannot be abstracted off and discussed as a physiological episode. We have to think of our share in the making of the next generation, and in sustaining the tradition of clean living and chivalry. We have to think also of the victims of selfish and cruel betrayal, and of the ranks of those who earn the wages of the dust. We must think also of the crime of poisoning wife and child, and of the many hard and ugly things that men and women do to each other (in the name of Love!) in the clash of their lives together.

It is impossible for reasonable men to regard prostitution as other than intolerable to their sense of honour, or to contemplate without shame the persistence of "the most mournful and the most awful figure in history," who, in Lecky's tragic phrase, "remains, while

creeds and civilisations rise and fall, the eternal sacrifice of humanity, blasted for the sins of the people."

TWO STANDARDS.—Most men of good-will are agreed as to the ideal—that men should be as controlled and chaste as good women. Many experts on sex-physiology have declared that the attainment of this ideal would do no harm. Self-controlled men, at all ages, are daily proving that the ideal can be realised. Yet too many "men of the world" declare that the ideal referred to is absurdly Utopian for ordinary masculine flesh and blood as known to-day. But even if it be the case that many *must* consume their living with harlots, which we do not for a moment believe, it does not follow that this is inevitable on the part of the more individuated.

It is often stated (by careful students of sex, as well as by the careless) that the normal Man's sexual appetites are, on an average, far keener and more insistent than those of the normal Woman. It is impossible for men without much (and obviously very difficult) consultation with good women to pronounce on such a matter, and perhaps there is a tendency to exaggerate the difference. Men know one side of the comparison, women know the other; the difficulty of collating them is obvious. We may refer, in illustration, to the fact that a woman's desire for sexual gratification, though it often needs clamant awakening, may become extraordinarily tyrannous—sometimes fatally tyrannous—to her husband or second husband; and, on the

other hand, to the fact that woman's greater control over her passions—for organic, ethical, and social reasons, and for fear of consequences—may lead man to conclude quite erroneously that these passions are much less strong than his.

The view of not a few experts is forcibly expressed by Mr. Heape (1913): "It is the fashion to talk glibly of the need for the suppression of brutal sexual instincts, of the control of sexual passion, and so forth. Such demands are made by woman and addressed to man as a perverted creature, as an abnormal product of civilisation. The fact is that woman's sexuality is on quite a different plane to that of man; she is wholly ignorant as a rule of man's normal requirements, and her virtuous demands, essentially designed for her own benefit as she conceives, are opposed to natural law."

It is evident enough from our book that we do not regard the sexual instincts as "brutal," yet we are inclined to think that women have considerable justification for being more than a little hard on men. What does Mr. Heape or any one else know of man's "normal requirements"? Can any one seriously doubt that most men are the better for the aids to sexual temperance?

Our view of the matter is that sexual desire is quietened in most women because they are more moralised than men; because they are in the direction of sexuality more controlled, because they do not relinquish their first line of defence so readily as man does, and so on: but that there is also a physiological

difference. It is not so much, however, that the sexual desire is not insistent in woman, but that she is so constituted that from wooing to consummation it takes longer for the brain to become eroticised, and for this to relax the control of the centres which normally inhibit response to sexual appeal. Hence, of course, the use of alcohol, which weakens all the control centres, in the devilish art of seduction. But quite as important is the psychological difference, that woman is less self-regarding, that she keeps herself better in hand, that she is more parental, even to her lover.

What of the common argument that the requirement of chastity should be less stringent in its application to man, because a woman cannot be physically the same again if she has been a mother, and in unchastity she runs this risk, whereas a man is physically unaffected by becoming a father? It can only be said that this popular apology is at once too abstract and too canine; it leaves out human considerations in pretending to emphasise them.

FACING THE FACTS.—Never was there such free discussion of sex questions as in these days; and much there is to alarm the timid, much indeed to repel. But here as everywhere the road lies forward, not back. We must grapple with each question, whoever be shocked; not shirk it, gloss it, retreat from it, in our feeble virtue. We must get at the facts—encouraging and disappointing; understand them; and then perchance see how to control them.

What is the ideal of life? What but the blos-

soming of noble (that is, pure) individuality, human and organic, into fulness, that is, of love, of sex? What better symbol (that is, sign) of these than the lily? And what clearer word of literal revelation, what simpler yet deeper word of initiation to both art and science was ever spoken than in the ancient counsel and command, "Consider the lilies, how they grow"?

Consider then the lily; face its elemental biologic-moral fact. "Pure as a lily" is not really a phrase of hackneyed sham morals; for it does not mean weak, bloodless, sexless. Its purity lies in that it has something to be pure; its glory is in being the most frank and open manifestation of sex in all the organic world. Its magnificent array is to show forth, not conceal: these wear their lucent argent for the passion-fragrant night, and these roll back their swart-stained robes of scarlet-orange to the sun-rich day; naked and not ashamed, glowing, breathing, warm, each flower showers forth its opulence of golden dust, stretches forth to welcome it in return. This, when we consider, is *How they Grow*.

We must face then the elemental fact of sex and love, making much not little of it, entering into it as into a great possession by which our own life and that of others may be enriched. And if there be strong love, much may be forgiven—even when it sweeps men and women off their feet. Through history, love has covered even the bar-sinister with its gold.

For here primarily lies the secret of the strength and courage of William the Conqueror,

here of the vivid heroism of Don John of Austria, and many a hero more; and in the converse ill-assorted *mariage de convenance* lies half the cause of the sinister devilry of Philip II, of Pedro the Cruel, of mad czars and imbecile kinglets without end. Here, in the virtuous, prudent, timid, sordid cloistering of French maid and man, lies the old decadence of the nobles of France, and—in part at least—of its analogue among the wealthy and governing classes of to-day. Similarly, in Scotland, in the exceptional freedom in marriage choice, in love-choice (illegitimacy and all), is one of the root explanations of the organic vigour, of the *ingenium perfervidum* of a strenuous race. There may of course, be base-born children without wedlock, but there are also too many base-born with it.

Are we therefore attacking marriage—"sapping the foundations of morality," as foolish people always say when they are asked to face facts? Not so, but defending marriage, re-defining it; making clear its fundamental and indispensable nature—the mutual selection of congruent types, at the culmination of organic and psychic life. We are deepening, therefore, the foundations of morality.

Over-toleration often means both moral and intellectual slackness, but we submit that social judgments on passionate lapses from the virtue of control may be unreasonably and unprofitably severe. When the lover and his lass lose their heads before they marry, their loss of self-control will certainly not make their married life happier; but it may have a virtue

which the "marriage for money," with all its respectability, never approaches. It is possible that the ignoble may ignobly use our words as a cloak for lust or for the devilry of seduction, but our apology is for love, and we side with Meredith: "Say not the mad, say the enamoured woman. Love is a madness, having heaven's wisdom in it—a spark. But even when it is driving us on the breakers, call it love; and be not unworthy of it, hold to it."

What the incontinent lovers have done is to spoil a very fine thing, but it does not merit social ostracism or lasting obloquy. It was not very long ago a general practice in some parts of the civilised world, sometimes lingering as a survival of barbarism, sometimes deliberately countenanced as a rough way of discovering whether the woman chosen could become a house-mother or not. In any case, our point is that those lovers who lost control have done far less harm to social stability than does the man who cannot look at a woman without lusting after her, and far less harm than the syphilitic who turns from his whoring to poison his unsuspecting wife, and kill or blind or rot their child.

When all is said, however, it must be admitted that irregularity in love-making is a bad start, and that there must be some good reason for the ancient and widespread social infamy of the bastard. The reason is twofold. First, because too often the psychical element is wanting, and then there is no marriage at all, but mere pairing of the lower animal sort; though perhaps even this is

better than the pairing of the lower plant sort which is the ideal of the *mariage de convenance*. Second, because mating, physical and psychic, can only be full and true when it is permanent—that is, when it goes on evolving throughout the lives it intertwines.

We have taken one instance of the need for a revision, or at any rate rethinking, of social judgments, and within our limits it must serve. But the reconsideration must be extended to other cases, sometimes perhaps confirming, sometimes perhaps modifying, current views. Confirming, for instance, the sanctity of marriage, for even apart from the claims and bonds of offspring and of society, the biological and psychic ideal is of permanent monogamy; the "primitive promiscuity" of which we used to hear so much being in the main an ugly dream, a disease-utopia of city degeneration under domestication, and probably not at any place or time a phase in the main line of human evolution.

In the reconsideration which is being forced upon us, three principles must be kept in mind: (1) Sex is a cardinal fact of life and one of the prime movers of progress. It has been well said that "there is gold and clay, sunlight and savagery, in every love-story." To increase the proportions of gold and sunlight is a task set all of us. (2) A sexually vicious habit of mind and body is something far more evil and destructive than is any single or even occasional lapse in temptation. (3) Irregularities in sexual behaviour or conduct have to be judged not

merely by their effect on the individual, but by their influence on the race; and the latter influence may operate either organically through the channels of inheritance, or socially by affecting social institutions and social sentiment.

IDEALS.—Even lovers recognise in colder moments, and dramatist and moralist are constantly reminding them, that the complete ideal has many elements, and that, alas! complete marriage is therefore mathematically unattainable for humanity—no such ideally complete physical, psychical, social and ethical culmination of life being even definitely imaginable. For, even granting the possibility of occasional perfection in either sex, we have a second improbability in the simultaneous occurrence of the ideally harmonious, yet contrasted type of the opposite sex, and a further improbability of their ever meeting. Hence appears one of the ways in which the ideal of celibacy is constantly reaffirming itself, and we understand better the monk and the nun, the misogynist and his counterpart.

Remembering the mighty urge of nature, we say that this ideal of celibacy is "not natural"; but this is to forget, for instance, the worker bees and ants and their vicarious parentage, the parallelism of bee-worker and woman-worker being almost painfully obvious. (Among the white ants half of the workers are arrested males.) In the maidenly reluctance which meets the masculine counsel, "Do not refuse love if it be offered," with "I'll never marry if I can help it"—there are

many elements. Some of these may be deplored—such as miseducation, arrested development, hyper-fastidiousness, and a selfish self-sufficiency; but there are others of a different sort, notably two. The reluctance to the loss of child-freedom, youth-freedom, the shrinking from the older and more passive maternal life—is one main element. But there is also an anticipation of the fuller maturity which lies beyond sex-love altogether, a recognition of a possibility (be this spiritual or social, as education, religion or temperament may determine) of a paradise “in which there is neither marrying nor giving in marriage, but in which we are as the angels of God in heaven”—or in more modern and everyday (yet happily also, not unspiritual) phrase—a “Society of Friends.”

Is it not a little significant that it is a religious society of that name who, taking them all over, seem most nearly to have realised their heaven upon earth? For to them the secular life of good deeds and social intercourse is most normally accompanied by the spiritual life. Is not this not merely in, but also largely through, that measure of sex-equality and sex-fellowship beyond that of other faiths and churches?

It should be noted, perhaps, that vigorous attempts were made in the early monastic times to establish mixed convents; and that these, despite all the difficulties and disappointments, did express a true ideal, namely of co-operation, not separation, of the sexes. Despite of failures and shortcomings, this ideal has actually been realised in many

ways—perhaps most effectively within recent years, albeit with a certain inevitable inhibition of distinctive sex-expression. Here, of course, is the great and pure, the ideal side of the Greek Hetairæ, of the ideal Abbey of Thelema; here too lies the reasonable side of the contentions of the freest novelists, so far as these express the ideal of men and women working together in frank fellowship, making their distinctive, yet mutually improved, contributions towards the betterment of the great human hive.

But the question of questions, in which religions alone have so constantly failed, and which it is the task of science to help them to answer, is: What of the actual and practical present? How shall we reach this fuller perfection of the human hive? Where has it been expressed in the world? Rarely, dimly, fantastically, if you will, yet surely in some measure in chivalry, which was no mere temporal ordering of things, still less an efflorescence of insincere sentimentality, but in large measure the provisional religion of Western Feudalism, which grappled more boldly than did the too passive orientalisms to which we have been wont to restrict the name religion, with the fundamental problems of our daily life.

In its noblest examples, the combination of activity with purity was practically reached; not evaded by help of separate cloister walls, as in the (so far profoundly less moral, however superficially more moral) discipline of monasticisms. For here lies the vital element of chivalry, that each sex not only expresses its

own quality, its own superiority over the other, but uses this to develop the other. The natural courage of the youth was not only developed by the danger of the quest, but refined by its discipline and patience. For the woman also this meant more than affection and constancy: for she might be not his love, but his lady only, the serene expression of his ideals or their arousing voice, and thus not only suggest his general line of action, but keep up his moral attitude in it. We are here reaching the fullest ideal of the woman-worker—she who works not merely or mainly for men as the help and instrument of their purpose, but who works with men as the instrument yet material of her purpose.

COURAGE AND KINDNESS.—What to aim at is clear, namely to set before man-child and maid-child, before lad and lass, man and woman, the elemental ideals of the sexes, of courage and affection. Let them, get them, set them to keep these respective ideals before each other. And so animal masculine courage combines with affection to rise into chivalry, magnanimous to others; the instinctive feminine affection rises through gain of courage into purity, reverential of self.

How work this out in detail? It is incipient wherever children meet at play. Here and there a woman is sometimes facing it in her kindergarten; a schoolmaster in his athletic field, in his boy-scouts; but the elaboration, the development, the organisation of all this is the highest task of educators, of men and women mutually trained and strengthened.

And here we are reaching the secret of the remoralisation of the sexes, of their highest individual possibilities, and this for and by lovers and celibates alike. Enough, however, if for the present we keep to the children. The boy's sword, the girl's doll; here nature gives the starting-points of the educator. Encourage, boldly develop, the game of war, let gun and trumpet have their little day, better now in nursery than later on imperial thrones. Drill and march, sham-fight and snow-fight; for it means discipline and valour; it means geography too, in which is all the stuff of science; it means history, in which is the stuff of literature. From holding a mimic hill-fort as ancient Britons, or storming it as Roman conquerors, and reading their Cæsar when tired of fighting, it is possible to advance through history with vivid, albeit simple, dramatisations. Fortification and engineering come in, experiments in peaceful handicraft—and discipline in enduring hardness—all half in play and half in earnest—at once a culture of courage and a preparation for life in the industrial world. Give them, too, with all this, story and song and ballad, give them individual banner and national flag, for here is the simplest concrete symbol of an ideal. These things done young enough, from war-game to peace-game the transition will be easy.

But the girls meanwhile? Where are they? Enjoying the fun, of course, first of all; it is no new physiology that laughter is trophic. How their presence intensifies the fighting, here rewards the victor, there consoles the

vanquished, is surely an old story; surely, too, how they teach fair-play, and in turn learn it, as they learn courage also. These elemental matters seen to, we are in a position to proceed safely to higher stages.

Let us set down our proposals clearly. Starting with the moral ideas of courage and kindness, we would discipline these in a corresponding practical life-drama; we would supply the corresponding intellectual instruction as need and opportunity arise; and we would have this carried out, as far as reasonably possible (and that is far), for and by both sexes. In short, we would reverse much in present codes and conventions of education, that separate the children; that set but intellectual tasks, irrelevant to their real life and interests, which are of play; that either starve practical activities or teach too tame and mechanical skills; that leave the untrained moral life, the inevitable sexual interest, to their fate amid evil chances.

IN SUMMARY.—What we must aim at is something positive, not negative; at the culture not of control merely, though that is much, but of the chivalrous spirit as well. All through civilisation the finest spirits have held by the tradition of subliming sex-impulses by associating them with the best that is in us. Sex is the physical condition of the finest possession we have; it offers opportunities by which we can build nobility into our lives. Our age is a difficult time of transition, but we cannot believe that men are going to drift away from the honouring of women or from being able to love them out of a pure

heart fervently. To serve an apprenticeship towards this chivalrous honour and controlled love of women is a great opportunity, and those who use it aright will by no means lose their reward. We do well to remember Comte's fine saying: "Between two beings so complex and so diverse as man and woman, the whole of life is not too long for them to know one another well and to learn to love one another worthily."

CHAPTER X

SEX AND SOCIETY

Biological differences between man and woman—Rôle of men and women in evolution—Critical and constructive—Conclusion.

To get a foundation from which to consider the rôle of the sexes in society, we must begin by referring to the structural and functional differences between Man and Woman. Prof. Arthur Keith's volume on *The Human Body* in this Library should be consulted in this connection.

BIOLOGICAL DIFFERENCES BETWEEN MAN AND WOMAN.—We have here to do with a particular case of the sex-dimorphism discussed in our fourth chapter. It is important to bear this commonplace in mind, for while there are undoubtedly differences between man and woman which are modificational or nurtural—the individual results of disparities or peculiarities in their education, training, and occupations, many of the differences

are constitutional, inborn not made. They are intrinsic, not tacked on; of ancient origin and therefore not liable to change quickly. They have a deep naturalness, and attempts to minimise them are not likely to spell progress. Some are trivial, some important; but they appear to be correlated. They are expressions which have from time to time been given to a deep organic difference between the sexes. They go through and through pervasively. As Havelock Ellis says: "A man is a man to his very thumbs and a woman is a woman down to her little toes." It is said that woman's eyelashes are in diameter a third thicker than man's. The differences can be read in the proportions of the body; in the composition of the blood; in the number of red blood corpuscles; in the pulse; in the periodicity of growth; and in the amount of salt in the composition of the body.

There is a whole series of anatomical facts which support the generalisation that in certain respects man's body is more specialised, going further away from the youthful and primitive type. This cannot be explained away as wholly due to difference in activities. It is partly connected with the fact that man is longer in reaching maturity.

Ranke notes that the typical female form has a relatively longer trunk, shorter arms, legs, hands, and feet; relatively to the short upper arms still shorter forearms, and relatively to short thighs still shorter lower legs, and relatively to the whole short upper

extremity a still shorter lower extremity—and so on. In short, the woman is a less muscular, less motor type.

The differences in the relative length of the limb-bones, and in the size and curves of the component parts of the pelvis, are observable at birth, but they may be obscured for a time by the different growth periods in the boy and girl. Thus the girl's period of most rapid increase in height falls usually in the twelfth and thirteenth year, while the boy's does not begin till the fourteenth and fifteenth year, and the period of increase in weight begins correspondingly earlier in the girl.

Much has been written about the difference in cranial capacity, but there is no certainty as to what that implies. Accurate measurements of the skull have been taken many times, and they show, according to Ranke and others, that the circumference of the skull is absolutely greater in the male, but relatively greater in the female. As to brain development, out of all the statements by later investigators the only half-certainty that emerges is that the central region, the seat of the voluntary movements, is rather more highly developed in the male.

Physiologists have of late years devoted much attention to the investigation of the glands of internal secretion, but it is too soon to generalise as to sex-differences. Bucura lays stress on the fact that the thyroid gland is not only relatively larger in woman but "plays an enormously greater rôle in her life." The same is true to some extent of

the pituitary body, which never entirely loses the increased weight gained in pregnancy.

It is to be noted that while these anatomical sex differences may be very slight in themselves, especially in non-typical individuals, the sum of them presents a picture which is quite unmistakable.

Tests show that the muscular strength of men is much greater than that of women. Of course the comparison must be made between those physically trained. Miss Helen B. Thompson's careful experiments confirmed the general verdict that women have much less muscular force than men. Feats like those of Newhaven fishwives in bygone days are well known; but on the whole man is the more muscular type, and especially stronger in relation to isolated feats and spasmodic efforts.

Probably correlated is the quality often called "energy,"—the characteristic masculine restlessness. We may speak of woman's constitution and temper as more conservative, of man's as more unstable. Man is more given to experiment both with his body and his mind, and with other people. Compared with women, men show greater frequency of genius, insanity, idiocy, crime, and many kinds of anomalies. In the same connection we notice that man uses more oxygen and combustible material, and has more waste in consequence; that man's blood has a higher specific gravity, more red blood-corpuscles, more hæmoglobin; that, in short, man is the relatively more active type.

Of some significance, again, is the relatively

great tenacity of life in women. They are longer lived. Alike in infancy and in old age they show a greater power of resisting death. Indeed at every age, except fifteen to twenty, their tenacity of life is greater than man's. Their constitution has staying qualities, probably wrapped up with femaleness.

We have said enough to illustrate the differences between man and woman; three general impressions are suggested by the inquiry. The first is that the differences are correlated, they hang together, they are outcrops of the deep fundamental distinction. We may say that the tenacity of life, the longer life, the characteristic endurance, the greater resistance to disease, the smaller percentage of genius, insanity, idiocy, suicide, and crime, and so on, are all correlated with the distinctively female constitution, which may be theoretically regarded as relatively more constructive in its protoplasmic metabolism.

Secondly, the correlation of differences includes the mental as well as the bodily, for we cannot separate them. We may assert this on general grounds which lead us to recognise the unity of the organism; but it can also be proved, in indirect ways at least. Thus we may refer to Karl Pearson's beautiful demonstration that the inheritance of well-defined psychical characters can be formulated like that of physical characters. "We inherit our parents' tempers, our parents' conscientiousness, shyness, and ability, as we inherit their stature, forearm, and span." The

psychical characters are inherited in the same way, and at the same rate as the physical.

Thirdly, we would guard against the temptation to sum up the contrast of the sexes in epigrams. We regard the woman as the relatively more anabolic, man as the relatively more katabolic; and whether this biological hypothesis be a good one or not, it certainly does no social harm. But when investigators begin to say that woman is more infantile and man more senile; that woman is "undeveloped man" and man an evolved woman; we get among generalisations crude if not unscientific and practically dangerous. Not least dangerous of these generalisations is one of the most familiar, that man is more variable than woman, that the raw materials of evolution make their appearance in greatest abundance in man. There seems to be no secure basis for this generalisation; it is still doubtful whether any generalisation of the kind is feasible. Karl Pearson has made seventeen groups of measurements of different parts of the body; in eleven groups the female is more variable than the male, and in six the male is more variable than the female. Moreover, the differences of variability are slight, less than those between members of the same race living in different conditions. Furthermore an elementary remark may be pardoned. Since inheritance is bi-parental, and since variation means some peculiarity in the inheritance, a greater variability in men, if true, would not mean that men as such had any credit for varying. The stimulus to variation

may have come from the mother as well as from the father. If proved, it would only mean that the male constitution gives free play to the expression of variations, which are kept latent in the female constitution. But what is probably true is that some variations find expression more readily in man, and others more readily in woman.

In regard to the mental differences between men and women, there is great difficulty in making definite statements until more experiments have accumulated. Moreover it is in this domain particularly difficult to discriminate between extrinsic acquired differences and intrinsic innate differences. It has been said that men have greater cerebral variability and more originality, while women have greater stability and more common sense. It has been said that woman has the greater integrating intelligence, while man is stronger in differentiation. "The feminine passivity is expressed in greater patience, more open-mindedness, greater appreciation of subtle details, and consequently what we call more rapid intuition. The masculine activity tends to a greater power of maximum effort, of scientific insight, of cerebral experiment with impressions, and is associated with an unobservant or impatient disregard of minute details, but with a stronger grasp of generalities."

Now it is "as easy as winking," as Carlyle said, to make statements like that, but their day is over. They are but guesses at truth without scientific precision. What we now require is an extension of experiments like those

of Miss Helen B. Thompson. She found that the ability to make very delicate and minutely controlled movements was slightly better in men-students. But may not this be connected with the greater use of knives and other tools? Ability to co-ordinate movements rapidly to unforeseen stimuli is clearly better in women. Women-students showed a greater power of distinguishing the higher and the lower notes of the tuning-fork. But may this not be due to more early training in piano-playing or the like? The eye of the man-student was on the whole more sensitive to light. The men perceived weak rays which were not seen by the women. Can this have to do with more open-air life in the case of the men? The women distinguished colours better. But is this not the result of training? Yet it is a proved fact that colour-blindness of all degrees is more frequent in men.

Women showed on the whole a better memory; they learned by heart more easily and retained as well. They required rather less time for the association of ideas. The men showed a decided superiority in quickness of perception as far as comparison could be made. In general mental content no differences could be established, naturally enough since all the subjects of the experiment had attended co-educational high schools. A few experiments are of more value than many platitudes, but the basis is still too narrow for safe generalisation.

Exact experiment on these lines—first laid

down by Fechner and Wundt—may yield us much valuable knowledge in regard to sex-differences in the senses and in mental content at the level of consciousness, but for the deeper psychological differences there must be added other methods of analysis. There is, perhaps, something to be hoped for along the lines of the "Enquête" or "Questionnaire" method so much used in America. This consists in sending out carefully framed series of questions, and collecting and comparing the answers, thus drawing upon the experience of teachers in schools and colleges, physicians and others with sufficient training and opportunity to give value to their observations. To this material must be added what can be gathered from biographical writings, from tradition and general observation as crystallised in proverbs and legends.

It is, as Bucura points out, especially in the domain of female psychology, that exact knowledge is lacking. Trained psychologists have hitherto been for the most part men, and they have dealt with general characters or with those of the male. And where the psychology of woman has been treated of, two or three possible sources of fallacy have to be taken into account. The male investigator may be reading his own psychological processes into his subject, so that his conclusions "are more likely to throw light on his own psychology than on that of his subject"; he will tend to know well women who are more or less alike, that is, of the type which he personally prefers;

and finally, in the case of an alienist or a physician, the women he has the opportunity of studying may be very far from the normal.

Bucura refers to a paper by Heymans, "Die Psychologie der Frau" (Heidelberg, 1910), as a good example of the combined method of exact experiment and analysis. Heymans agrees with most other authors in regarding women as much more emotional than men, and he refers many of the other sex-characters—such as incalculability, a tendency to self-sacrifice, and inferior sense of justice—to this greater emotionality, which has a physical basis and is correlated with the greater, vasomotor excitability. Other so-called feminine characters, such as dissimulation, and a lower regard for truth, he regards, with Finot, as merely the weapon of the weak, and maintains that they are no more marked in women than in men where there is a reasonable equality in their relations to one another.

Interesting too, is Heymans' discussion of the "divination" or "intuition" of women, which he regards as due to the greater rôle played by the subconscious in them, the whole mental processes of association and deduction remaining subconscious and only the result emerging. In this connection, the analytical method of Freud and his school, which we have referred to in a previous chapter, is of great interest.

Thanks to Weismann in particular, biologists have become vividly aware of the importance of discriminating between modifications and variations. Any one can see that there are

differences between the members of a species; some of these can be shown to be due to peculiarities in the individual's "nurture" (food, atmosphere, surroundings, education, exercise, habits, etc.); and it is only when we subtract all these acquired modifications from the observed differences that we get at the inborn variations, the germinal new departures, which are the raw materials of evolution, and the basis of what we call individuality.

Now it must be noted that the majority of even the current comparisons of men and women are vitiated by ignoring this familiar biological distinction. Woman is set up against man, or man against woman, to the disadvantage of one or the other, without inquiring whether the opportunities of development, *i. e.* expression of the inheritance, have been approximately equal. It is of the very A B C of embryology that inherited characters require a succession of appropriate liberating stimuli if they are to develop. If these stimuli are supplied to boy and youth; and denied to girl and maiden, no scientific comparison of innate ability is possible. It is obviously incumbent on inquirers to try to discriminate, in comparing Man and Woman, between the innate qualities of maleness and femaleness, masculinity and femininity, all requiring appropriate liberating stimuli, and those which are individually acquired as the direct result of peculiarities of "nurture." Along with these must be included the defects that are due to disuse, or to the absence of appropriate stimuli.

RÔLE OF MEN AND WOMEN IN EVOLUTION. Man's work and woman's work form the warp and woof of civilisation, and the inter-twining is so intricate that the discrimination of contributions to any particular pattern is extremely difficult. We cannot do more than attempt to illustrate the respective rôles of man and woman in evolution. We shall refer to the mother-age and the patriarchate of old, and the industrial revolution still of but yesterday. The important general idea to be borne in mind is that our present social state is like a countryside with a complex geological structure, with outcrops of strata of very diverse ages. Barbarism is not dead; the mother age still lingers; the patriarchate is in great force;—in short, in spite of our rapid social evolution there are abundant survivals in culture.

THE MOTHER-AGE.—“Prehistoric history” is hazardous, but there is a good case to be made out for the reality of a primitive “mother-age.” This has been reconstructed from fossils found in the folk-lore of agriculture and housewifery, in old customs, ceremonies, festivals, dances, games, and songs; in myths and fairy-tales and age-worn words.

Prof. Karl Pearson finds in the study of witchcraft some of the fossils that point back to the matriarchate. In the older traditions “the witch resumes her old position as the wise woman, the medicine woman, the leader of the people, the priestess.” “We have accordingly to look upon the witch as essentially the degraded form of the old priestess,

cunning in the knowledge of herbs and medicine, jealous of the rights of the goddess she serves, and preserving in spells and incantations such wisdom as early civilisation possessed." The witch's weather-wisdom is congruent with the fact that women were the earliest agriculturists; her knowledge of herbs with that of the ancient medicine woman; her *diablerie* with the ancient group-relations of the sexes so different from what we call marriage to-day; her nocturnal dances with the ancient choruses of marriage-ripe maidens. The authority and the magic circle kept by her broom are those of hearth and floor in her primeval round-hut; and her distaff and pitch-fork, her cauldron, her cat and dog, are all in keeping with the rôle of woman in the mother-age.

But there is another way, and that certainly not less reliable, by which we can arrive at some understanding of the mother-age, and how it naturally came about, namely, by a study of our "contemporary ancestors," as they have been called, that is, of peoples who linger on the matriarchal level. Such peoples, as well as others at the still lower nomad stage of civilisation, are to be found at this day in Australasia.

While the purely nomad stage lasted, little progress could be made, because the possessions of a group were limited by the carrying powers of its members. But in a favourable forest spot a long halt was possible, the mothers were able to drop their babies, and give a larger part of their attention to the business

of food-getting. As before, the natural forest products—roots and fruits, were gathered in, but more and more time and ingenuity were expended in making them palatable and in drying and storing them for future use. The plants in the neighbourhood, which were useful for food or for their healing properties, were tended and kept free of weeds, and by and by seeds of them were sown in cleared ground within easy reach of the camp. Animals gathered about the rich food-area, and were at first tolerated—certain negro tribes to-day keep hens about their huts, though they eat neither them nor their eggs—and later encouraged as a stable source of food-supply. The group was anchored to one spot by its increasing possessions; and thus home-making, gardening, medicine, the domestication of animals, and even agriculture, were fairly begun. Not only were all these activities in the hands of the women, but to them, too, were necessarily left the care and training of the young.

The men, meantime, went away on warlike expeditions against other groups, and on long hunting and fishing excursions, from which they returned with their spoils from time to time, to be welcomed by the women with dancing and feasting. Hunting and war were their only occupations, and the time between expeditions was spent in resting and in holding interminable palavers and dances, which we may perhaps look on as the beginnings of parliaments and of music-halls.

Whether this picture be accurate in detail

or not, there is, at any rate a considerable body of evidence pointing to the "matriarchate" as a period during which women began medicine, the domestication of the smaller animals, the cultivation of vegetables, flax and corn, the use of the distaff, the spindle, the broom, the fire-rake and the pitchfork.

In the mother-age inheritance of property passed through the mother; the woman gave her children her own name; husband and father were in the background—often far from individualised; and, indeed, too shadowy for wholesomeness; the brother and uncle were much more important; the woman was the depository of custom, lore, and religious tradition; she was at least the nominal head of the family; and she had a large influence in tribal affairs.

What can be inferred in regard to primeval days seems to bear out our view that certain differences of capacity between men and women are of remote origin and became organic very early. Man, stronger and more agile, was a hunter and a fighter; a premium was put on device and a certain kind of inventiveness; he came into wider relations than his women-folk. Male types without these qualities would be eliminated; the surviving type would gradually become relatively masterful, restless, pugnacious, inventive, and co-operative—not by individual acquisition, though that would help indirectly, but by the hereditary accumulation of constitutional variations in the direction stated. That, at least, is our theory. And to the

question, "But would the daughters not inherit their father's as well as their mother's qualities?" we must answer that it is one of the mysteries of inheritance that it is often sex-limited. That is, it remains latent in one sex, whether for lack of the appropriate liberating stimulus in the environment, or because inhibited by the constitution of the organism.

In the same way, if the theory of the mother-age stands, we must regard woman as becoming very early the organic repository of other great capacities, complementary to man's. It is very interesting, if true, that women began domestication, agriculture, medicine—all of them what might be called "nurtural" activities. It is certain that woman was from the first organically more moral than man in relation to offspring; it is probable that she early developed a home-instinct congruent with her nature.

The matriarchate gave way because woman made home-life too comfortable, because population increased and game decreased, because man became more domesticated, and later on, less of a huntsman and correspondingly more of a worker. Moreover, between the tendency to masculine dictatorship always renewed by war, and the preponderance of the patriarchal order congruent with pastoralism, the position of the matriarchate could never have been a very stable or secure one.

We are thus brought to the transition period when the matriarchate has lost its

distinctive features and the patriarchy has not yet been differentiated. The kin-alderman usurps chief power in the group and dominates the women. "The property still passes through the women, but the king has taken possession of them. The sex-custom of the group has become exogamous, but property does not descend from father to son." This is a period to which hundreds of fairy tales refer, notably of the Ashiepatle and Cinderella type, in which the son of the people, helped by the wise woman to whom he is kind in the forest, travels to another kingdom, and, after exploits, marries the king's daughter and inherits his domain.

PATRIARCHAL PERIOD.—Let us now turn for a little to the definitely patriarchal period, with early phases of which the Old Testament has made us familiar, in which descent through the male line has been established, in which women have lost most of their communal influence. To this day some will speak of "the head of the house," going back to the time of the tribal father with his subject wives, when the women of the house did not inherit property, but were property.

It is the fashion of some—women especially—to find nothing but abuse for the patriarchal order, but the nature of things is to some extent independent of their organisational form. "For forms of government let fools contest; whate'er is best administered is best" may be a mugwump's doctrine, but there is some sense in it. Given sound economic conditions, wholesome occupations,

a country life, a healthy stock, and a good-going controversy between character and ideals, and perhaps it does not matter very much whether the framework is patriarchal or matriarchal. But when things go wrong—and that is often—then organisational form becomes important, as a means to an end. What is plain is that there was black and white in all the periods. The patriarchate may imply domestic tyranny, even unto this day, but not necessarily. Thus Prof. Earl Barnes reminds us that the Hebrew woman of the Proverbs shows us “a singularly free and secure industrial position.” Man’s jealousy on behalf of his wife may have implied Moslem-like restrictions, but it was also a factor in developing a tradition of respect. That many of us look forward to more active sexual selection on the part of women does not hinder us from recognising that the patriarch’s sexual selection, perhaps a little bucolic, may not have been a bad thing for the race, nor for women either.

Again, it was probably in the early days of the patriarchate that capable women began the well-concealed art, in which they were till lately past-mistresses, of governing indirectly. It is indeed remarkable to notice how many great men who have made history, have had their Egeria, and this in any and every line of life, from Pericles with his Aspasia to Luther and Katharina.

In the course of its evolution the patriarchal dispensation encountered many modifying influences. Chief and most penetrating of

these was Christianity. There is room for a long discourse here, but we can only allude to four points. The first is the far-reaching effect of a belief in the value of the individual soul. It is very noteworthy that a due valuation of women and a due recognition of the worth of the individual go hand in hand. The re-assertion of the freedom of the individual at the Reformation had some complement in an improved attitude to women, and other examples might be given. This is one of the reasons why the Woman-cause and the Labour-cause must go together. The second point is simply that the genius of Christianity which sublimed the commonplace tasks of life into an apprenticeship of the heavenly citizen, also made for the ennoblement of every human relationship, including marriage. What Christianity in essence should have meant for women, must be distinguished from what actually came about. And again, while biologists cannot but regard the celibate ideal as erroneous for the individual and disastrous in its racial consequences by removing so many of the best ears from any share in the seed-corn, and dissent from the false shame which did long and lingering harm by branding sex as animal or even devilish, we must recognise all the great work the church did in opening avenues of culture and of usefulness to Plato's children of the spirit.

The period of chivalry, too, was not without its great influence. There was a beneficent humanisation of feeling towards women.

The ladies were defended and honoured and idealised, often obeyed; and the working-women got considerable protection with a new kindness. The well-known and diagrammatic illustration that the woman with child had a right to game and fish from the lord's preserves, and a right to gather in fields and orchards, points forward to a kind of protection which the socialistic sentiments of our modern civilisation, as they reach towards concrete expression, may again sanction and develop.

Some students of the chivalrous period have pointed out, and with some authority of scholarship as well as reason, that the dominant attitude of man to woman during the chivalrous age was that of every militarist period—that of the Cave Man, the forceful master. It is enough to admit the commonplace that each thesis, from that of the matriarchate to that of the most modern feminism, from that of the patriarchate to that of the anti-suffragists, has its corresponding antithesis.

Christianity did much for the status of women, increasing culture did much, and women-geniuses did much, but the general ideas of the patriarchate required another kind of hammer to break them—and that hammer was *economic*. "The commercial and industrial system, and the general diffusion of education that has accompanied it, and which has also its roots in economic causes, has been the chief motive force in revolutionising the status of women."

The ordinary household industries—spinning, weaving, storing and the like, which were economically so important that they absorbed the energies, not of the house-mother alone, but of all the unmarried females of a family, gradually dwindled in importance. Enormous numbers of young women were partly driven by necessity, but partly also attracted by prospects of independence, into working in or for the factories, and thus the authority of the head of the household was weakened. Even the house-mother herself was often forced into outside labour, and the distinctive features of the patriarchal home disappeared.

But there were equally important if less directly obvious effects on the relatively comfortable classes. Many of the activities of the middle-class woman became superfluous, since the same results could be less expensively attained by mechanical means. Improvements in household arrangement lightened domestic toil, and many a wife, who could afford to have help for the harder part of the work, found that the administrative duties which remained afforded a wholly insufficient outlet for her energies. Even the essential function of motherhood was not left unaffected, for actual number of births ceased to be a criterion of social worth, as brain replaced muscle in importance. It is interesting that this point finds definite expression in modern literature. In Brieux's play, *Maternity*, for instance, when the falling birth-rate is being discussed at a meeting

of mayors, when the argument that agriculture requires an increase of population is urged, the farmer among them replies: "I have a reaping and binding machine; it does the work of a dozen men, and only cost a thousand francs. A child costs more."

Mrs. Olive Schreiner, in her recent book, points out that at this stage, as at many other times in the history of civilisation, the danger of what she calls *sex-parasitism*, became acute. We owe to this noble writer a fine historical analysis of this *corruptio optimi pessima*, though perhaps she exaggerates the economic factors at the expense of the psychological. By the sex-parasitism of woman is meant the condition of dependence for support on the performance of her sex-function alone, or even on "her mere potentiality in the direction of a duty which she may never fulfil." Mrs. Schreiner's thesis is that the parasitism of the female has periodically come in as a great middle term between the anti-social accumulation of wealth on the part of the dominant class or race and the degeneracy and ineffectiveness of the males, which is followed of course by racial decline.

CRITICAL AND CONSTRUCTIVE.—We have outlined the biological view that there is a deep constitutional distinction between man and woman, and that this finds expression in a large number of detailed differences, which are natural in origin and natural also in having survived ages of elimination. Coming now, to practical theses, we may notice first

that some of the educational and occupational differentiations of man and woman in past times have been harmonious and consistent with the fundamental divergence. It seems consistent that men should fight, if there must be fighting; and that women should nurse, when nursing is necessary. Man hunted and explored, woman made the home and brought up the children. Man sailed the seas, woman developed home industries. Woman is naturally a teacher of the young, a domesticator, a gardener, and so on. Scores of these harmonious differentiations still exist.

This historical commonplace need not be elaborated; but it suggests several remarks of importance. (1) When we say that this or that occupational differentiation is natural to woman, we do not simply mean that it has been sanctioned by convention. We mean that it is congruent with femaleness, that it occurs in many races and countries, and that it has stood for a long time the test of eliminative selection. (2) The harmless historical commonplace has sometimes been used to discourage the education of women and the widening of her share in the world's work. "Her place is in the home," it is said. To which it might be answered, firstly, that much depends on the nature of the home. It was a very many-sided home in which woman evolved. And, secondly, that in the present condition of things, in Britain for instance, a very large number of women never have what most men and women mean by a home. (3) And, again, the historical

commonplace has sometimes been used by those who are women's best, if not always wisest, friends. Some who have a firm grip of the fact that women are wives and mothers at heart, who are also influenced by the prevalent technical education fallacy of our day, have advocated a more predominantly domestic and maternal education for girls. But there are great dangers in exaggerating what in moderation is sound enough. A broadly educated intellectually alert mother means much for the mental atmosphere of the home, and that means much for the children. But an over-emphasised domestic education is apt to force a premature development of mental and perhaps bodily instincts, which in many cases will find no realisation in life.

Our second thesis is the converse of the first. It is that coercive differentiations inconsistent with the natural distinction have often been attempted, with unfortunate results. This misdifferentiation of women demands, like the harmonious differentiation of women, a careful historical survey, but we cannot give more than a few diagrammatic illustrations. Women have been used to draw the plough and to work in the mine; they are still employed as coal-heavers. They are still too often to be seen bent and worn by severe physical tasks. Much of this is disappearing, but it is still necessary to say that the use of woman for functions which should be discharged by a beast of burden illustrates misdifferentiation. It is destructive of the

individual; it is not less destructive of the vigour of the race if it occur during the years of child-bearing and child-rearing.

Let us pass to a very different instance—the taking of the veil, once regarded as the highest devotion of a woman's life. Everyone recognises the beautiful significance of the step in particular cases, and the social utility of those who age after age have been truly called sisters of mercy; but this does not lessen the disadvantageous influence of an ideal that renounced most of the natural activities of woman and involved an indubitably great loss to the quality of the race by its segregation of many of the finest types.

But we do not require to go beyond the present for illustrations. Economic conditions are compelling women, in competition with men, into occupations and situations which are too hard for them, where the strain is too great, especially in adolescence, and where regularity of attendance is so stringently enforced that health suffers. Where sex is ignored and where no allowance is made for maternity, there is bound to be mis-differentiation. Where mothers are concerned it is certain that the wear and tear, the strain and continuity of the modern competitive system, whether in professional life or among hand-workers, must be prejudicial.

What to do is another matter. Much will depend on the growing organisation of woman-workers, much will depend on the developing social sentiment and the legislation to which

that leads. Just as there is the beginning of the insurance of women against a possible spinster-poverty, so there is the beginning of a state-recognition of the fundamental service of motherhood. And as there is social sentiment that rewards the victims of war with Glory and Pensions, is it too much to hope for progressive social sentiment which will equally reward the victims of Maternity? A stock argument used in defence of unequal political treatment of men and women is that men, in the long run, may be called upon to do what women cannot be expected to do—namely fight. But to be set against this is the fact that men are not expected to bear children.

It may be said, however, that this incongruent differentiation that we have been speaking about is of less importance, seeing that most of the women-workers are unmarried. Of less importance, doubtless, but of great importance still. Not only in affecting the national expense of caring for invalids, but also in prejudicially affecting the prevalent feminine type—the significance of which may be realised without going deeply into social psychology. It must be remembered that although many of these girl-workers and women-workers remain unmarried, it is from among their ranks that the mass of wives and mothers come.

To everyone, of course, it is obvious enough that girls and women do not strain themselves for fun, but because they are in the grip of an apparent economic necessity. This may be

sadly true, but it is the biologist's business to consider things biologically not economically,—to point out inevitable consequences irrespective of costs. As a matter of fact, the conditions of work for women, as for men, are modifiable, and they have in many cases been greatly improved. But what has to be steadily faced is the fact that misadjustment leads to biological inefficiency, which is terribly expensive for the race. Biological efficiency is the silver at least of our national wealth; while money is but its bronze or nickel.

Critics of the feminist movement have urged that one of the most obvious mis-differentiations of woman is seen in the absurd attempts to over-educate her. This is much more than a jibe. It must be admitted, for instance, that one of the serious difficulties that confronts us is the alleged relatively great infertility of types and stocks of high intellectual and social efficiency—for it is urged that the infertility is the nemesis of higher education and of individuation generally. Herbert Spencer argued that reproductivity decreases as individuation increases, and there is a considerable body of biological evidence in support of this generalisation. It must be observed, however, that we have no proof that high individuation directly lessens fertility. What the evidence from the animal kingdom shows is this, that when birds, for instance, were evolved with big brains and strong parental care, it was possible to survive with very much smaller families: those types that varied towards better brains and more parental

care on the one hand, and towards economised reproductivity on the other, were naturally the survivors. But it was not the heightened individuation that directly lowered the rate of multiplication, although as individuation increased it became possible for the multiplication to be decreased. It must be observed also, that part of the reduced fertility may be due to hypernutrition and the like, to the frequent absence of love-marriages, to selfish celibacy and selfish non-maternity. The highly individuated high castes of Brahmins and Rajputs show none of the usual dwindling tendency.

It is conceivable that the endeavour after self-realisation at a high level of culture may be so strenuous that it induces conditions tending against the making of good wives and mothers, but it can hardly be maintained that the deplored results are inevitable or intrinsically connected with the education. They are partly due to fictitious obstacles thrown in the way of feminine education. But to admit that artificial and readily alterable conditions may tell against what the Germans call full motherhood and strong children, is a very different matter from admitting that higher education is, biologically considered, bad for the race.

Here it may be fitting to refer to the ever-returning suggestion that the intellectuals among women should keep themselves free for work in the world which needs them so badly, and should leave it to their more placid, less ambitious, less intellectual sisters to be

the wives and mothers. Those who admire the bee-hive will even point to it in support of their thesis, for the queen-mother's brain does not develop so well as that of the workers.

But the biological objection is just the same as against nunneries. We cannot countenance a theory which deliberately leaves maternity to the less intellectual. In addition to the clever mother's contribution to the organic inheritance of the child, there is the hardly less important nurtural influence in the home. The idea of leaving maternity to a docile and domesticated type, of cow-like placidity, while the intellectuals run the world, is quaintly non-biological.

We come, in conclusion, to the third side of our thesis,—that the lines of evolution to be followed are those which seem likely to make the most of the deeply rooted organic distinction between male and female, and to make the most of those masculine and feminine characteristics that have proved themselves for ages of vital value.

Taking a simple illustration first, we submit that Man—both male and female—is a very slowly varying organism, though he hides his persistence of type under ever-changing garments of acquirement and convention. In spite of affectation and pose there is still a wholesome abundance of that mutual attractiveness of complementaries which has given a spice to life from the beginning, and is of enormous biological importance. We venture to say that attempts to lessen the old-fashioned natural differences are to be

regarded with extreme suspicion. There is a wholesome natural prejudice against the masculine woman and the feminine man. What an engine of progress there is in sexual selection, we shall more clearly realise when economic conditions make more discriminate preferential mating on the woman's part possible.

And if it be important, as we have just hinted, that the culture of the body should be congruent with the fundamental distinction between male and female, and should make the most of the normal masculine and feminine attractions, the same is true in regard to the contrasted intellectual qualities of, let us say, mental experiment on the one hand, and rapid intuitive insight on the other, as also for the complemental moral qualities of courage and affection. We have perhaps got away from the stupid survival of discussing the superiority of one sex or the other; but we have not sufficiently freed ourselves from obscurantism, since we are so slow to act constructively, in education, for instance, in the way of making the most of the complementary differences.

Thus in the prolonged discussion over the pros and cons of co-education, how rarely has it been pointed out that neither method is ideal, for it is quite plain that boys and girls, men and women, should be taught together for certain reasons, and taught separately for certain other reasons. There are different studies, and different modes of presentation for the two sexes, if we are to make the most of their respective excellences. As Alsberg

has said: "The real task of the feminist is to devise an education for girls so that they shall be capable of earning their living and sharing in the world's work and yet remain fit for the future wifehood and motherhood."

Another step leads us to the technical education for the professions, and here the biological counsel must be the same—that we should seek to make the most of the complementary qualities. One of the keenest of intellectual combatants has said that, apart from maternity, the woman of strong physique or strong intellect may excel in any pursuit whatever her average male compeer. With this we entirely agree, but we submit that it profits national efficiency more when gifted women do what no man could do so well, or when men and women work together as naturally as they once played together. We must be content with one illustration. It is well that medical schools and medical posts should be open to women of special aptitude. There must be free experiment if social efficiency is to be attained. But from our general biological point of view, it seems that the most promising line of experiment would be that of providing specialised education for medical women—not "easier" or "lower," or any nonsense of that sort, but *different*—so that there might arise not duplication of one type of medical servant in the State but two distinct types of medical servant. It must be urgently emphasised, however, that the fittest medical education for women is not likely to be that which men, in their wisdom,

prescribe, but that which women, with a free hand, work out for themselves.

It is an ordinary rule of life that we try to find out the kind of work which is natural to us, and seek to make the most of our particular machinery, keeping economy of energy as well as efficiency in view. And our main thesis is just this same simple one applied to man and woman, that the most hopeful line of evolutionary experiment is that which seeks to make the most of the deep organic differences which were rooted long ago in the lowest parts of the earth. As Ellen Key has declared, to put women to do men's work is as foolish as to set a Beethoven or a Wagner to do engine-driving.

If we suppose, as we may continue to do for some time yet, that most women wish to have homes and husbands and children, we have to face the problem of combining maternity and citizenship, production and reproduction. As Prof. Karl Pearson wrote in his famous essay on "Woman and Labour" (1904): "The race must degenerate if greater and greater stress be brought to force woman during the years of child-bearing into active and unlimited competition with man. Either a direct premium is placed upon childlessness, upon a crushing out of the maternal instincts on which the stability of society essentially depends, or woman has a double work to do in the world, and she can only do it at the cost of the future generation." How, the same author asks, can woman continue to do freely what she alone can do for society and yet have

full power to control her own special activities and develop her own individual life; in short, feel herself a free citizen of a free State?

Just as a large class of the male community has accepted the special protection of labour, so, Pearson maintains, women must do when their movement becomes more solidary. In certain careers we already see capable women giving men points and beating them hollow. But even at this level they might be the better for special social protection; for instance, that a combination of professional work and maternity might be possible. But when we consider the growing ranks of working womankind—dressmakers, clerks, typewriters, designers, etc.—we see the force of the argument that a demand for special legislation and special protection must replace the cry for equality of opportunity which marked the earlier stages of the woman's emancipation movement. "To reconcile maternal activity with the new possibilities of self-development open to women is *par excellence* the woman's problem of the future. It is not one which can be solved by 'equality of opportunity,' but solely by the recognition of maternity as an essentially social activity, by the institution of some form of national insurance for motherhood, and by the correlated restriction and regulation of woman's labour."

Towards these ends the enfranchisement of women is a means, justified for that end; and also rendered almost imperative as a removal of an inhibition which has very detrimental effects on the minds of many men.

Whereas the British phase of the woman's movement has been most marked by the cry for political justice to one half of mankind, the German, or wider Teutonic and Scandinavian movement may be described "as based on the demands of woman the mother, and as directed to the end of securing for her the right to control and regulate the personal and social relations which spring from her nature as mother or possible mother." In fact instead of "Votes for Women" the cry is "Mutterschutz," for the mothering of mothers. Of course, as Havelock Ellis says, "these German women fully recognise that women are entitled to the same human rights as men, and that until such rights are attained 'feminism' has still a task to achieve."

It rests with women, in increasing measure, to control reproduction, spacing out the child-births, or even avoiding the production of undesirable children. It rests with women, in increasing measure, to secure that the mother is no longer exhausted by too continuous maternity—an alleviation of which would also yield a better quality of babies.

It rests with women also to use the powerful lever of sexual selection, by giving the preference to mates who are more likely to beget "super-men" (of either sex, of course). Woman should not be too hard on the tyrants of the patriarchy, for they probably helped to evolve her beauty, but only a partisan will deny that sexual selection has been one-sided for many centuries. As women attain to

economic independence, sexual selection will become better balanced.

Let us again emphasise our point that the evolution of civilisation has brought us to face problems which women are more capable of solving than men. The responsibilities of women are correspondingly great. "An enlightened culture of motherhood," eugenic practice in regard to child-bearing, the education of the young child—these are essentially woman's problems. And if we are to look hopefully to the future, she must face up to taking her share in readjusting marriage laws, in working out specialised lines of education, in trying to lessen sweated labour, and in helping to solve the problem now so closely bound up with it of prostitution.

The scientific position must be sceptical and careful. Civilisation is so complex and changeable that not the wisest can see more than a few moves ahead. It is like looking at the development of an animal whose adult form is unknown; we see a group of cells here and another there, and we think that they are shaping as if they were predestined to become this organ or that, but who can be sure? The more living a thing is the more it shows of the unpredictable and the unexpected. Therefore we are not in sympathy with those who dogmatise on what they call the fit and proper lines of feminine evolution. Who can tell what men or women can do effectively until a fair trial is made? Social evolution is an experimental art. And one quite unworkable plan is that man should

prescribe what the lines of woman's evolution are henceforth to be. On the other hand, we are rational beings who can learn from past history, and it is our prerogative to swim, not drift, in social evolution. We can ask questions of the past; we can analyse the present; we can get from both some basis for deliberate programmes for the future.

CONCLUSION.—We have now summarised, and so far as our space allows sustained, the claims of woman. Mainly no doubt as approached from the organic side, with its individual and its family aspect, as is fitting in a book primarily biological; but also, briefly upon the political side as well. The economic revendications of woman as depressed labourer have likewise been argued for, her business capacity recognised, and far fuller scope for her too little utilised administrative aptitude is pleaded for. Yet all such discussions of the woman question, varied and copious though they nowadays are, seem to us as yet insufficient, and at best but preparatory towards yet larger discussions—those of scheming out the possibilities of woman as active citizen; and more concretely still, towards experimentally opening out her goodly share in inspiring and in conducting that renewal of cities and city life which is at length happily incipient.

Let us state this problem in yet another way. What may be the place of woman in the contemporary transformation of the industrial age? This transition, as we are nowadays beginning to see, is clearly distinguished;

as that from paleolithic to neolithic, old stone age to new; for our contemporary transition is far too scantily described by the body of contemporary economists as a mere strife between labour and capital within the all-dominant "Industrial Age"; and still more unsatisfactorily expressed, as too much by liberal politicians, in terms of its earlier struggle with the renaissance or medieval elements of society, incomplete though this birth-struggle may still be. The essential transition is that in progress within the Industrial Age itself, that between its initial lower phase to the incipient higher one—in a word, from the past century of paleotechnic industry, mechanical, militant, monetary, to the opening one, that of a neotechnic civilisation, founded upon more skilled and scientific industries and arts, and aiming towards truer peace than any which can be guaranteed by armour; and towards these ends sustained alike by synthetic intelligence and by creative idealism.

On one side is the present dominant civilisation—of coal and steam, of machinery and cheap products, of expanding markets and widening empires—themselves groaning under ever-increasing armaments, torn by fiscal disputes, and ruled by the financiers' assumed omnipotence. From this standpoint, this order of things—avowedly mechanical, militarist, and monetarist at best, and thus too readily becoming debased, violent and venal—seems to many of us, perhaps as yet to most, the only possible form of

industrial civilisation, of which therefore we can but make what small temporary and philanthropic alleviations as we can. For this, the history of the past is but of fading shadows; and even the "progress" of which it has boasted so much is too little to be estimated in quality of life, however easily in quantity. Towards these quantitative estimates, we have indeed masters of statistics; and their records are convincingly impressive. See in the Canadian news how we pull down our corn-elevators to build greater—and in South Africa how fast the Tubercle Mine and the Long Ankylostome are being sunk to meet the Bottomless; or now that City Improvement and Town-planning—still too much in Second Empire form—are coming into fashion, how unprecedentedly the plan of Chicago grows, extending the street we last lived in, from fifteen miles of seldom-disturbed dirt by fifteen more of mathematical dreariness! Each is in its way a triumph beyond question; but wherever any words be said of progress in quality of civilisation and of life towards its ideals, then there is silence; or if that will not answer, a very tumult of utilitarians and paleotects crying out with one voice: "Away with these Utopians!"

Yet the advance quietly making, in our own generation, since Ruskin was thus hooted out of economics, is that his prophecies of the final social economy we here call neo-technic are actually coming to pass. This is still no doubt but the day of small things, but the leaven has been at work, and the

good seed growing. Though there still survive "practical men" and self-styled utilitarians, sneering at all things beyond their paleotechnic disorder as "mere Utopia," the practical Eutopians are already at work, and even drafting, as here, their historic estimate of the receding futilitarians.

Yet our term for the incipient order as neotechnic is itself technic, as masculine labour and thought must mostly be. Complemented by feminine effort and inspiration, it becomes eutechnic, expressing the inspiration of labour by art and beauty. Our aims are not only synthetic, as men-philosophers say, but applied—that is geotechnic, as with practical women, who, as the anthropologists confess, had the first word in cultivation, and have certainly the last word in home-making, as all can see. This nascent order is seeking to be eugenic, as the patriarchal Galton, and his well-meaning under-shepherds of the Eugenic Society would have it; but motherhood, from its simplest to its divinest levels, has ever discerned that the essential condition, alike of the new young life and of its evocation, is to be eupsychic.

Eutechnic, Geotechnic, Eupsychic—is this at length our view of progress? So it has long seemed to us, as men working and thinking, from the substages of the paleotechnic order to those of the neotechnic; and each in its way so far analysed and generalised. Yes, yet no: one further connection is needed; for if these were all, the paleotect may say, and not without an element of justice, that

these are but what he too was aiming at all along, in the three phases we have so harshly criticised. Instead of denying this, let us rather see and confess the dangers of these new stages repeating the errors of those they seek to replace. Once more feminine intuition and mother-wit, and even its oldest traditions, aid us; for is not the right order of these three the very reverse of that in which we have been following the paleotects? Should it not be, as every woman knows, first ethical and social, that is eupsychic, and thus eugenic; then synthetic and geotechnic; and thus educative and healthy? These clearly presented in thought, and aimed at in consistent action, there will be no fear of eutechnics. For if we are first seeking the ideal in society, and its expression in the community, in the city, in the family, then the individual mind will be sane and strong; and if so, the body will function at its very utmost health, and even prolong and increase this. But given socially inspired and civic purpose, vivid mind and vital muscle, then gesture will be graceful, but that is art; grip will be stout and sure, and that is labour: yet both reunited, in craft; and no longer dissociated and futile, as at present, between factory and studio, slum and drawing-room. This central antithesis of paleotechnic and neotechnic, thus involves the passage from the predominant mechanocentric thought and philosophy of industrial man to the originative, biocentric instinct and inspiration of domestic woman.

Thus, in a word, we find ourselves meeting Bergson upon a fresh path ; and this practically and concretely, as we began, with a reading of the interplay of the sexes in society. Interplay in ways beyond the sex-antagonisms, the alternating revolts and repressions of the moment ; yet not so far away as to the active combatants at present seems.

Cherchez la femme is no mere gibe, but as true a word as ever was spoken in jest : even to-day it is a working maxim for the detective as well as a staple element of plot for his story-teller. In history we have long been accustomed to think of this feminine influence as on the whole unfavourable, from the fall of man, the war of Troy to the latest society scandal. But this plainly is but at most a half-truth, and the lower half at that.

Here lies before us a lecture-syllabus of "Women in the Making of History," by Miss Alice Shield, unfortunately never now to be delivered, yet surely to be handed on : a noble history, of women Greek and Roman, woman as Christian and Martyr, women of chivalry and romance, women in defensive war and patriotism, women of the Renaissance and the Reformation, women of the Cinquecento, the Grand Siècle and the Augustine Age, women of the Revolution, and women of Modern days. Here plainly is a sign that the writing of history, even in our Universities is not to be permanently smothered in charter-chests, but is coming forth anew, to fuller life and completer humanity. As professors writing history,

students reading it, men have thus no longer their old monopoly : for here are Clio and her maidens re-writing and re-reading history together ; while her sister Calliope, the heroic muse, is seeking how to renew her world-old share in making it. And though thus to some the muse of Tragedy seem also approaching, Polymnia with her wisdom is not hopelessly far away.

Does this long argument seem far-fetched even outside our theme of sex ? Not so ; that is but the fault, and the difficulty, of our exposition. Put most simply and broadly it amounts to this—that in these lower and still predominant phases of modern life we call paleotechnic, woman has no organised place, save as drudge to machines, as camp-follower to imperial armies, or as white slaves for finance. Whereas, in the neotechnic order, already happily and demonstrably nascent, woman reappears as all she ever was at her best ; and it yet may be more—as eupsychic inspirer and eugenic mother, as instinctive synthetist, as educationalist, as orderly home-planner and citizen ; and, by her guidance of consumption, directing industry and skill, ennobling utility into art.

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